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ELECTRIFICATION ON A LARGE SCALE.

A note appearing on another page of this issue explains the situation confronting the Southern Pacific Railroad on its mountain division. On this section of the road the grades are steep and continuous, there are thirty-one miles of tunnels and snow-sheds, and there is but a single-track road, although over this must be passed all the traffic to and from central California. To increase the traffic-carrying capacity of the road it might be double-tracked, but the expense of doing this is prohibitive. Two possibilities remain: the construction of another line, constituting practically a second road, or electrification of the present road, and the possibilities of the latter solution are now to be studied seriously, as indicated by the engagement of Mr. Frank J. Sprague as consulting engineer to cooperate with Mr. Allen Babcock, the present electrical engineer of the company. They are to study all the possibilities of electric operation, to report on the matter, and upon this report will largely depend, of course, the action of the company.

The work to be done here differs very considerably from any that has yet been undertaken in this country. Some years ago it was proposed to adopt an electrical system in one mountain section of the Baltimore & Ohio Railroad, in order to increase the capacity of the line; but this work was never carried out. The problem presented to the Southern Pacific Company is much harder than the other—in fact, it seems even more difficult of solution than any other electric-railroad problem which has yet arisen. It is one, mainly, of increasing the capacity of the mountain line without involving too great an expense. The question of economy hardly enters in at all, as all the traffic of the Union Pacific Railroad to and from central California must be forced through this section of the road. Should it be decided to proceed with the electrification, this decision would most assuredly have an important influence in bringing about the electrification of other difficult sections of railways which often influences considerably the amount of traffic handled by an entire system.

This news is very interesting, for besides being important from an electrical standpoint, it is significant to note that this road, which is one of the Harriman lines, is earnestly studying the problem of future growth and planning for an increase in traffic which can only be secured by the expenditure of millions of dollars, in spite of the facts that money for development purposes is difficult to get to-day, and these lines have been the special targets for press and official criticism for some time past. The problem would hardly be taken up at this time if the railroad's officials did not feel on very secure ground.

THE PROGRESS OF MUNICIPAL ELECTRIC LIGHTING.

In the current issue of the *Municipal Journal and Engineer,* Mr. Ernest S. Bradford presents an analysis of the present conditions and statistics dealing with the municipal electric lighting plants in the United States. His figures show that, numerically, the municipal stations are more important than is usually assumed, as there are 1,096 municipal plants to 3,305 private plants. He points out, however, that this comparison does not represent the true condition of affairs, as the greater number of the municipal plants are small, and but few large, and therefore figures showing the total cost of construction and equipment represent the condition more accurately. These figures are not available the present year, but from the census report of 1902 an idea of the relative investment in the two types of plants may be obtained. This report showed that the cost of construction of the 2,620 private plants then existing was $482,700,000 in round numbers, and that the 815 municipal plants at that time in operation cost $22,000,000. The ratio here is roughly one to twenty, the numerical ratio, as already shown, being about one to three. Here again, however, the comparison is not altogether satisfactory, since a good deal of the investment in these plants represents equipment which has been scrapped. A comparison between the gross incomes of the two groups of plants seems somewhat better, and this shows that the private plants during 1902 had a gross income of $78,700,000, which is about eleven times that of the municipal plants, their income being $6,965,000. This ratio of one to eleven falls about midway between the other two ratios, and probably represents most accurately the relative importance of the two groups of stations.

Mr. Bradford then compares the ratios of municipal to private plants in the different sections of the country. The extreme eastern and extreme western sections show the smallest ratios, as the number of municipal plants there seldom, with one or two exceptions, exceeds twenty per cent of the total. In the intermediate states, that is to say those groups known as the Middle West and the southern states, the proportion of municipal plants is considerably larger, as here it seldom falls below twenty per cent, and in some cases is over fifty per cent and even sixty per cent. He attributes these differences to the fact that in the eastern group of states private plants obtained a pretty secure footing before it was seriously proposed for the municipalities to undertake the work. In the extreme West, where in one sense the country is newer, more is left to individual effort to develop the country. In the southern states development, retarded for some time, has begun again actively, and here, when the question of lighting the towns comes up, there is not so often a private plant to combat the undertaking on the part of the municipality. In these states the author believes the municipal movement is spreading rapidly, and he thinks that, should some plan of conducting municipal government be evolved which will give more satisfactory results than those at present employed, the general propagation of municipal lighting will be much hastened. He asserts that the change from private to municipal plant is much more frequent than a change in the reverse direction, saying that during the twenty years from 1881 to 1902 only a baker's dozen changed from municipal to private, when 107 installed municipal plants.

These figures are somewhat interesting when compared with a series of reports published in the New York *Sun,* August 22, which came to hand the same time as Mr. Bradford's study. This paper reports that the Galena, Ill., lighting plant, which has been operated for a number of years, has been sold to a western syndicate for much lower than the original cost, and a contract entered into with this company for furnishing the light for the city for twenty-five years. This plant, it is said, never paid expenses. It reports also that the bankers of Washington, Ind., had refused to advance any more money for the operation of the municipal plant there. It is said to be in a bad condition, and the citizens of the town are advocating selling it or abandoning it, securing light from a private company. The *Sun* reports also that the municipal plant at Topeka, Kan., shows a steadily increasing deficit, and the citizens are anxious for a change. Further reports state that at Council Bluffs, Iowa, at Dubuque and at Cedar Rapids there is great dissatisfaction with the municipal water-supply systems, and the prospect for increasing the responsibility of the municipal governments is anything but favorable. These press reports, dealing with the states included in one of Mr. Bradford's group where municipal-ownership movements were said to be most encouraging, are not quite in accord with his views. One more plant, at least, has changed over from municipal to private, and two others seem to be well on the way toward this end. These newspaper reports deal, of course, only with a few isolated towns, and due allowance must be made for this fact, but they seem to show that the course of the municipalizers is not plain sailing everywhere.

LIGHTNING RODS FOR POWER PLANTS.

In a recent issue of the journal of the American Society of Naval Engineers, Mr. W. M. Hopkins discusses the problem of protecting power-house chimneys from lightning strokes, and he gives a set of specifications which is reprinted elsewhere, apparently resulting from his experimental investigation of this troublesome and important problem.

Mr. Hopkins points out the disrepute into which the old Franklin lightning rod has fallen, and says that this is due to the unsatisfactory application of Franklin's system. He describes the two types of lightning discharge, as classified by Lodge, the one being a discharge from cloud to ground, and the other a secondary discharge from cloud to ground resulting from a primary discharge between clouds. The first of these may generally be taken care of by means of a pointed rod—in fact, the very idea of the rod is to prevent such discharges, as it relieves the dielectric strain and allows the energy of the cloud to be dissipated quietly. The other discharge is more troublesome, as the strain comes upon the dielectric suddenly and there is no time for quiet relief. To prevent damage due

to this discharge the old shape of lightning rod is of little use, as, due to its oscillatory character, the easiest path for the discharge is not always down the rod. The plan proposed to take care of these discharges is to place a cage of copper over the top of the chimney, connecting this to a suitable number of rods running vertically to the ground. In this way, it is said, a flash of lightning which might otherwise find the path to ground through the hot gases of the chimney easier than that through the rods will be deflected, and passed to ground in the proper way. In his experimental investigation of the subject, Mr. Hopkins used a Tesla coil giving frequencies of 200,000 cycles, and he found that for such frequencies a cage as proposed was very effective. With higher frequencies, which undoubtedly do exist at times in lightning discharges, the cage would probably become less effective.

The specifications as written up call for lightning rods of stranded copper wire carried on metallic brackets not insulated, from the chimney and connected together by a copper ring at the top of the chimney, from which project a number of vertical rods, each tipped with a sharp point. These rods are connected together by the cage mentioned above. The method of securing a satisfactory current is explained in detail. The use of copper for the rods is good, because this is less affected by corrosion than iron. The better conductivity of the metal is of little value to such oscillatory discharges.

Judging from Mr. Hopkins's article, the best way to protect a building against lightning is to surround it with a metallic cage, as described by Faraday, and to surmount this with many points. He refers to a certain German powder mill which is protected by several miles of barb wires presenting over a million sharp points. The problem is not as troublesome as that of protecting an electrical distributing system, since all the disturbance originates outside of the building itself. But, on the other hand, when a stroke of lightning does fall upon a building, the energy which this represents is in a condition which is very hard to control. Thus, although it may be small in amount, it may do a great deal of damage before it can be properly dissipated. If it could all be transferred to water, heating and converting this to steam, the amount of water thus evaporated would be surprisingly little. On the other hand, the rate at which this evaporation would take place would give rise to a violent explosion.

The methods proposed for protecting chimneys are certainly in the right direction. It has become customary in the last few years to place a crown of points on tall chimneys, but the methods of connecting this to the ground have received less attention. Certainly, two or more rods will be safer than one, and the cost is a trifling matter compared with the cost of the apparatus protected. The adoption of the cage on the top of the chimney is simply another step toward the ideal metal sheath which Faraday proposed. It would be very interesting to know how successful these specifications are in securing protection for the government buildings, but of course it is very difficult to draw deductions in such matters, since in most cases the apparatus protects without giving any evidence of its effectiveness.

THE TUNING OF WIRELESS TELEGRAPH SYSTEMS.

At the recent meeting of the British Association for the Advancement of Science, Sir Oliver Lodge explained the methods which he has employed in tuning wireless telegraphic stations. This is of interest, because up to this time the lack of a successful method of tuning has been one of the great handicaps of the wireless system in use. Another, as noted recently, was the unsatisfactory state of our knowledge regarding the method of transmission and the effect of atmospheric conditions. The latter, though not clearly understood, has, it seems, been partially overcome, as both Marconi and Fessenden announce that they have developed methods which enable communication by day to be had as satisfactorily as at night. These announcements make the question of tuning of even greater importance, since without satisfactory tuning the field of wireless telegraphy can be but limited.

For long-distance transmission Marconi endeavors to produce a sudden, violent discharge. This kind of discharge is not suitable for tuning in which a prolonged discharge is desirable in order that the accumulated effect of a series of waves may be utilized. If the receiving device be so sensitive that it responds to every slight disturbance, tuning can not be easily carried out; but if it be insensitive, so that it requires twenty successive impulses or more to bring it into action, then tuning may be effected, provided a method of producing such discharges is available. For this purpose Sir Oliver has found that a suspended antenna not connected to the earth is the most satisfactory. He uses for this purpose two capacity areas, both elevated above the earth. Here a difficulty comes in, for if the two areas be placed close together the radiated power of the system is decreased, and if the lower one be brought nearer to the earth, the latter begins to interfere with its action; and if it come in contact with the earth or be connected to it, the discharge becomes almost dead-beat and not oscillatory.

This kind of discharge is best given by an alternator with a wave-shape which is not a sine curve, but one with a flat top, so that it maintains a potential necessary for causing a discharge for a sufficient time to emit a train of waves. He has found also that if the spark-gap be surrounded by ionized air, this character of discharge is facilitated.

Sir Oliver says that by this means it is possible to obtain tuning within five per cent; that a change in frequency of this much will throw out one receiving station and bring in a neighboring one; but in practice it would be undesirable to work quite so close as that. With changes of that order of magnitude, however, several neighboring sending stations can be made to send to several neighboring receiving stations without interference. This corresponds to diplex telegraphy, not to duplex.

With this method of tuning, dependence is placed upon the receiving apparatus rather than upon the ability of the receiving station to sift out those disturbances of improper frequency. It would seem that until this can be done that duplex transmission will be impossible.

Possible Electrification of a Division of the Southern Pacific Railroad.

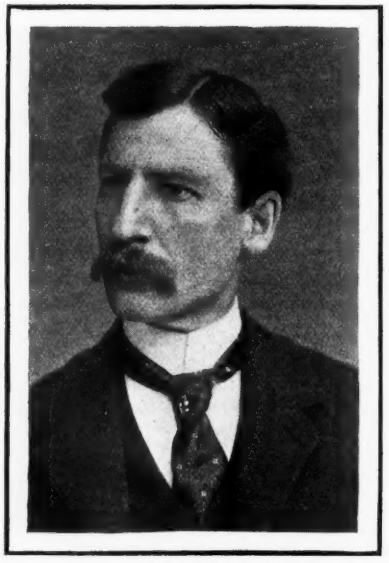
After the New York Central and Hudson River Railroad and the New York, New Haven and Hartford Railroad commenced the electrification of their divisions, adjacent to New York city, this work is referred to frequently as the largest and most important electrification which has been undertaken, and even to-day one instinctively thinks of the work in the eastern states when heavy electric railroading is mentioned. Nevertheless, there is a problem at present being studied in the Far West which seems more difficult than the conversion of a city terminal from steam to electricity, and which probably will be more expensive. This is the problem of increasing the capacity of that section of the Southern Pacific Railroad which crosses the Sierra Nevada Mountains. This division is 136 miles long, running easterly from Rocklin to Sparks. It is a part of the Sacramento division of the Southern Pacific Company, this being a direct western continuation of the Union Pacific Railroad. The possibility of electrifying this section of the road has been made a special study by Allen Babcock, electrical engineer of the Southern Pacific Company. The problem is one of exceeding difficulty, and differs greatly from the conversion of a city terminal for handling of congested traffic.

Over this section all the freight and passenger traffic of the Union Pacific road to and from central California passes. The road here is a single track line, with many sidings, high curvature, and over thirty-one miles of tunnel and snow sheds. The traffic is very irregular, though heavy, and at times up to the full capacity of steam operation. Looking towards the future, it has been decided to investigate the possibilities of increasing the traffic and capacity of the line by a change of motive power. This and the building of another low grade line seem to be the only feasible methods of meeting future increase in business.

The difficult character of the problem is due to the length of the line and the irregular, but heavy traffic, and also to the grades, as all the east-bound traffic must be lifted nearly 7,000 feet within eighty-three miles.

As mentioned before, Mr. Babcock, the company's electrical engineer, has had this problem under consideration for some time. Recently Frank J. Sprague has been retained to cooperate with him in making a report to a board, of which Mr. Sprague will also be a member, upon the various electrical possibilities. This board will be of an advisory character, and will determine broadly whether electrification can be depended upon to produce the necessary increase of traffic facilities, and if so, what is the most likely method of application. The board, with the exception of Mr. Sprague, is composed of officers of the road. Should it reach a favorable conclusion, Mr. Sprague will be retained as consulting engineer by the road.

Some idea of the serious character of the work may be gained from the fact that freight trains, 1,000 tons or more, must be put over the line at greatly increased speed, and the fact that the average grade in the eighty-three miles referred to above is over one and one-half per cent, while



Mr. Frank J. Sprague.

at times the grade is two and one-half per cent. The locomotives at present in use burn oil, and are of good steaming qualities. It would be impossible to haul trains over this division by means of coal, for during the winter certain sections of the mountain division are covered with snow twenty feet deep.

It is not learned that Mr. Sprague has formulated any definite conclusions of what system or methods will best satisfy the conditions existing. It is quite certain, however, that the problem is such as to make necessary a very careful study of what has been accomplished by the various electrical systems which have up to the present time been tested thoroughly, and also what may be looked for in the near future. Mr. Sprague has already been over the line making a special study of the situation, and expects to do so again within a short time. This road is one of the Harriman lines, and it is rather significant that the problem of electrification as a means of increasing traffic should be taken up seriously at this time, as only a short time ago, while discussing the possibilities of increasing railroad capacity, Mr. Harriman said that it is practically impossible to increase the gauge of the lines, however desirable this might be, and the only other promising solution at present seemed to be electrification.

Mr. Sprague's retention comes just as he has completed four years as consulting engineer in the electrification of the New York Central's terminal, the new engagement very naturally following from his experience in this important work, as well as from his wide experience in electric railroad matters, in which he has taken such a leading part.

The Convention of the Illinois State Electric Association.

The eighteenth annual convention of the Illinois State Electric Association was held more or less on board the steamer Illinois, the convention taking the form of an outing rather than a formal session. The members assembled at Peoria, Ill., on August 14, at 10 o'clock in the morning. The boat proceeded to La Salle, *via* the Illinois river, about 100 members, including, of course, the supply men, participating in the trip. Arriving at La Salle, the party proceeded on special cars to Starved Rock Landing, from which point a steamer trip was made to the cañons, the steamer later returning to Starved Rock, where a banquet and vaudeville performance were given at the hotel. The return trip to La Salle was made the next day at 1 P. M., and the trip from La Salle was continued at 1 P. M. on Thursday.

During the convention the nominating committee presented its report, which was accepted as follows: president, E. L. Brown, Elmwood; first vice-president, F. M. Sinsabaugh, Carrollton; second vice-president, E. W. Smith, Kewanee; third vice-president, W. G. Austin, Effingham; fourth vice-president, H. A. Foster, Pontiac; secretary, H. E. Chubbuck, La Salle; treasurer, E. MacDonald, Lincoln.

A very pleasant feature of the excursion was the presentation of a gold-headed cane to retiring president Shumway, and of a diamond-studded charm to Mr. Chubbuck.

The Canadian Electrical Exhibition.

The Montreal Electrical Show, under the auspices of the Canadian Electrical Exhibition Company, Limited, will be held in the Government Drill Hall, from September 2 to September 14, inclusive. This promises to be one of the best shows ever held in the Dominion of Canada. It is the first of its kind in seventeen years, there not having been any electrical show since 1890, when a small exhibition was held in one of the local skating rinks. The Drill Hall affords a space of 150 by 275 feet. The promoters of the exhibition have arranged for the Canadian Electric Light Association, the Maritime Provinces Electric Light Association and the Canadian Street Railway Association to hold their annual conventions in Montreal during the time of the show. There will be a display of electrical decorations, including an electric fountain, a dancing skeleton, demonstrations of wireless telegraphy, and experiments on high-tension static machines. The entire management of the show has been undertaken by R. S. Kelsch, vice-president and managing director of the Canadian Electrical Exhibition Company. W. McLea Walbank is president, and J. W. Pilcher, secretary-treasurer of the company.

The following names of exhibitors and allotments of space have been announced:

Allis-Chalmers-Bullock, Limited, E-1, 2, 3, 6, 7, 8, 9.

American Conduit Company, F-6.

Bell Telephone Company, B-2, 9.

Canada Electric Company, F-16.

Canadian Buffalo Forge Company, F-7.

Canadian Fairbanks Company, B-5.

Canadian General Electric Company, C-12, 13, 14, 15, 18, 19, 20.

Canadian Westinghouse Electric Manufacturing Company, B-16, 17, 18, 19, 23, 24, 25.

Dominion Steel Works, D-14.

Dossert & Company, A-6, 7.

Economical Electric Lamp Company, A-10.

Electrical Review, F-15.

Electrical World, F-18.

Fibre Conduit Company, A-4.

Garth Electric Company, E-14, 19.

G. M. Gest, F-13.

J. A. Dawson & Company, E-4, 10.

Jenkins Electric Company, C-6, 11.

John Foreman, Montreal, C-3, 4, 8, 9.

McDonald & Wilson, B-1, 8.

Midland Electric Company, B-12.

Montreal Light, Heat and Power Company, D-1, 2, 3, 7, 8, 9.

Montreal Steel Works, E-5.

Munderloh & Company, A-15, 16, 17, 18.

Northern Electric and Manufacturing Company, D-17, 18, 23, 24.

Packard Electric Company, D-4, 5, 6, 10, 11, 12, 13.

Mr. W. McLea Walbank, President of the Canadian Electrical Exhibition Company, Limited.

Eugene Phillips Electrical Works, F-8, 9.

R. E. T. Pringle, Montreal, C-2, 7.

Sawyer Electric Company, C-22.

Shawinigan Company, D-20.

Mr. R. S. Kelsch, Vice-President and Manager of the Canadian Electrical Exhibition Company, Limited.

Shepherd Engine Company, B-6.

Stratton Engine Company, B-13.

The Robert Mitchell Company, B-14, 21.

Watson, Jack & Company, B-15, 22.

Wire and Cable Company, Montreal, B-3, 4, 10, 11.

W. J. O'Leary, A-8, 9.

United States Navy Standard Specification for Lightning Rods.[1]

Chimney Protection for Power Plants—Lightning conductors shall be laid up in the form of a seven-strand cable, and each strand laid up with seven copper wires of No. 10 Brown & Sharpe gauge. For chimneys of fifty feet and less in height, two lightning conductors shall be used. For chimneys over fifty feet, up to and including 100 feet, three conductors shall be installed. For chimneys higher than 100 feet, four conductors shall be installed. All heights to be considered from ground level. All conductors or cables shall be symmetrically arranged about the chimney with one cable on the prevailing weather side of the chimney. Said lightning conductors or cables to be securely attached both mechanically and electrically to independent, pure copper earth plates or bars. In cases where the chimney foundations have already been filled in, instead of earth plates earth terminals may be used, composed of pure copper bars three inches by one-half inch by three feet. In all cases the lightning-conductor terminals shall extend to the ground water level, and in no case shall they extend to less than fifteen feet from the ground surface. Earth plates shall consist of pure copper three feet by three feet by one-eighth inch.

Application of Conductors to Chimney—Each lightning conductor shall be secured to the exterior of the chimney by means of bronze or brass anchors, without the intervention of any insulators or insulating material whatever. The brackets for attaching ring or conductors to chimneys to be of high-grade bronze or brass, composition of same to be submitted for approval, and to be fitted with approved clamps for securely gripping said conductors and making a good electrical connection therewith. The tongues or shanks of the anchors or brackets shall enter the masonry of the chimney a distance of at least six inches, and shall be at least one-eighth-inch in thickness by one inch wide, terminating in a suitable head or angle, to prevent the anchor from being pulled out of the masonry. Anchors to be attached to conductors at intervals of not over ten feet and sweated to the conductors with solder at intervals of fifty feet. Conductors to terminate within five feet of the top of the chimney, and to be connected through the agency of suitable brass or bronze fitting and be soldered to a one and one-half

[1] From an article on "The Development of Standard Lightning Protection for Power Plant Chimneys at United States Navy Yards," contributed to the *Journal* of the American Society of Naval Engineers for May, by N. M. Hopkins.

inch by one-half inch ring of copper attached to the periphery of the chimney by brackets spaced not over two feet apart; said brackets to enter the brickwork a distance of at least six inches and to be of approved design, with a tongue at least one and one-half inches in width and one-fourth inch in thickness, with a suitable angle or head to prevent pulling out. All joints in the continuity of said copper ring as well as between the continuity of the ring and conductor or conductors running down to the ground bars or plates, and including the latter, to be scraped bright, and, after making a secure mechanical joint, to be "sweated with solder." Said solder shall consist of equal parts lead and tin. All joints when finished shall be thoroughly washed off with water to remove every trace of soldering salts, acids or other compounds used. All joints secured by bolts or screws to be locknutted. In applying conductors where the chimney is already constructed holes shall be drilled in the brickwork, and said anchor brackets and anchors grouted in, the best Portland cement being used.

Terminal Rods for Lightning Conductors—Copper ring shall be connected through the agency of clamps, insuring a good mechanical and electrical joint, with vertically arranged copper rods, at least three-fourths-inch diameter and ten feet in length. The joints to be "sweated with solder" as before described. Copper rods to be placed equidistant around this ring, and supported in a rigid position vertically, through the agency of additional anchors set in the masonry and a copper spider resting on chimney top as shown in the drawings. Rods to be arranged with a uniform spacing of practically four feet. This is taken to mean, for example, that ten such vertical rods shall be provided for a chimney of twelve feet outside diameter of chimney at top.

Discharge Points—Each rod shall terminate in a two-point aigrette, each spur or point of this aigrette to be at least three and three-fourths inches long, the bases of which spurs shall be at least three-eighths-inch in diameter, tapering to a sharp and well-finished point; said aigrette to be provided with approved means to secure a strong mechanical and electrical joint with the vertical rods heretofore described and to which it is attached. The joints shall be "sweated with solder" as heretofore described.

Chimney-Base Protection—All lightning conductors shall be enclosed at bottom with a heavy galvanized iron pipe of one and one-half inches in diameter, and extending three feet into the soil and ten feet above. Said iron pipe to be provided with approved brackets to securely hold it to the chimney; brackets to be not over three feet apart.

Inspection—No scaffolding shall be removed before inspection of the lightning-conductor installation shall have been made by a Government representative.

A Steerable Street-Car Truck.

A steerable, or rather flexibly suspended street-car truck has been brought out by the Warner Engineering Company, of Westminster, London, England. The object of this design is to allow the axles of a four-wheel truck a certain amount of movement, so that they can adjust themselves to irregularities in the track or unequal diameters. The truck is carried by means of links swung from the axle boxes, to which they are connected by knuckle joints. This enables the box to tilt itself and rotate to and fro on the journal, and thus permit the axle to adjust itself to the track or to return easily to a central position should it run to one side. The suspension is so flexible that the body of the car can easily be swayed by hand.

Electrical Material for the Bureau of Supplies and Accounts.

The Bureau of Supplies and Accounts, Navy Department, will open bids at Washington, D. C., on September 3, 10 and 17, for the following electrical material: cable and wire, miscellaneous, Charleston, S. C.; cable, conductor, etc., 9,500 feet, New York, N. Y.; cells and batteries, thirty-one, torpedo station, Newport, R. I.; electrical supplies, miscellaneous, Charleston, S. C.; electrical instruments, six, Charleston, S. C.; electrical instruments, twenty-two, New York, N. Y.; generator, motor, ten-kilowatt, one, Norfolk, Va.; motor, series-wound, fifteen-horse-power, one, Boston, Mass.; poles, telephone, twenty, Charleston, S. C.; receiver, electrolytic, one, torpedo station, Newport, R. I.; tape, insulating, 400 pounds, League Island, Pa.

New York City Offices for Electrical Companies.

Quite a number of electrical companies will have offices in the City Investing Company's new building, Broadway and Cortlandt street, New York city. The American Car and Foundry Company will occupy the front of the twenty-third floor. The Westinghouse Companies will occupy the twenty-first and twenty-second floors. The American Gas and Electric Company, part of the nineteenth floor. The Electric Properties Company, part of the nineteenth floor. The General Electric Company will occupy the entire twentieth floor.

The Caffaro Electric Power Station.

The mountain river Caffaro has its source in the Adamello range, situated on the frontier between Lombardy and Austria-Hungary. Its normal flow is 140 cubic feet a second, but the lower portion of its bed shows a fall of 820 feet in a distance of three miles, thus rendering 13,000 horse-power theoretically available. Another fall somewhat higher up can be regulated, which will yield an additional 6,500 horse-power, or a total of approximately 20,000 horse-power from this otherwise insignificant stream. The lower fall has been utilized by the construction of a barrage in the vicinity of Bagolino township. The spot chosen was favorable for the work, as the stream at that point was narrow and slightly above it there was a natural basin. The dam is sixty-nine feet long, six feet in average thickness. The water is carried from this point in a conduit and through tunnels to a forebay built at Monsuello, 820 feet above the power station. From the forebay two penstocks, each about three feet in diameter, run down the hill to the power-house, the upper part of the penstocks being of lap-riveted, the lower of lap-welded steel plates. The generating station contains three Pelton wheels, which, operating under the effective head of 808 feet, develop about 2,500 horse-power at a speed of 315 revolutions a minute. There are also two small Pelton wheels of 160 horse-power each, which drive the exciters, and a third driving a continuous-current dynamo for lighting the station. The alternators generate current at 10,500 volts, forty-two cycles. It is then stepped up to 46,000 volts for transmission purposes. The step-up transformers are fitted with double cast-iron shells, between which water is circulated for cooling. The inner chamber is filled with oil. The switch gear is located in a room adjoining the generating room, all high-tension switches being placed in concrete cells. Power is taken from the generating station to a transforming and distributing station at Brescia, a distance of thirty miles, where it is transformed down to 3,600 volts. The insulators on the transmission line are of the umbrella type, ten and five-eighths inches in diameter and eleven and thirteen-sixteenths inches high. They are of local manufacture, and are tested wet up to 90,00 volts. The transmission line is a copper wire a quarter of an inch in diameter. Two thousand kilowatts, supplied from this station, is used in soda works, where the Kellner process is employed. The remainder is distributed for power at Brescia and neighboring districts.—*Engineering (London), August* 9.

The Seventy-seventh Annual Meeting of the British Association, at Leicester, England.

By John B. C. Kershaw.

THE seventy-seventh annual meeting of the British Association for the Advancement of Science, which was held at Leicester from July 31 to August 7, under the presidency of Sir David Gill, was a very successful gathering, although the number (1,621) attending the meeting has been lower than the average for recent years.

The actual work of the association is now carried on in eleven sections. The recently introduced plan of arranging for discussions upon topics of live interest in each section is extending, with great benefit to the usefulness of this annual parliament of science.

The "Engineering Section" was this year presided over by Professor Sylvanus P. Thompson, and papers upon the problems connected with the design and working of gas engines were given the place of honor in the programme.

A group of papers more especially relating to electrical engineering were read and discussed upon Monday, August 5. In Section A, which deals with "Mathematics and Physics," the subject of Helium and the dissociation of the atom was once again discussed by Sir William Ramsay, Professor Oliver Lodge, Professor Rutherford, and other investigators in this fascinating domain, and Sir William Ramsay gave some details of his latest laboratory results in the transmutation of the elements.

In the following report, attention is confined to seven papers and addresses which will be of special interest to readers of the ELECTRICAL REVIEW, restrictions as to space making it necessary that the number abstracted should be thus limited.

ADDRESS TO THE ENGINEERING SECTION BY PROFESSOR SYLVANUS P. THOMPSON.

Professor Thompson in his presidential address dealt with the development of engineering as a branch of scientific knowledge, and with the close connection between science and practice in engineering work.

Passing on to consider the history and development of electricity as a motive power, he made use of a paper read by Robert Hunt before the Institution of Civil Engineers in the year 1857, and contrasted the position and use of electricity in the arts and industries to-day, with the opinions expressed by Mr. Hunt, and such authorities as Mr. Grove, Lord Kelvin, Mr. Smee, Mr. Joule and Faraday, fifty years ago.

In the final portion of his address, Professor Thompson dealt with the education and training of engineers, and attacked the premium system which has had a great vogue in the United Kingdom. The best training, in his opinion, is that outlined in the report of the special committee appointed in November, 1903, by the Institution of Civil Engineers to consider the subject. This report was published in 1906.

THE PRESENT POSITION OF GAS AND PETROL ENGINES.

Mr. Clark stated that the present position of the internal-combustion motor industry was one of sound prosperity, and that as regarded the construction of engines of moderate power, manufacturers had attained practically to a fixed type. Experience in the construction and design of large gas engines was also accumulating, and it was a remarkable fact that engines which had attained a great success upon the Continent had required to be modified in details of construction before success was attained in the United Kingdom. These larger engines had in fact been much improved during the last few years and, as a result, were better able to compete with the steam engine, as regarded reliability and freedom from breakdown.

Passing on to consider the source of power, Mr. Clark stated that coal gas and gas produced from anthracite was too costly for large engines, and that practically all the large engines now running in Europe were using blast-furnace gas. The problem of large gas engines was therefore intimately connected with the development of the bituminous fuel gas-producer, and this latter was still in the experimental stage of its development.

According to Mr. Clark, the successful producer for use with bituminous fuel is more likely to be developed in the United Kingdom than in Germany, both Mond and Crossley being at work upon the practical solution of this problem.

Passing on to consider his own contributions to the theory of gas-engine construction and working, the author stated that one of the chief problems at present was how to reduce the cylinder size of large gas engines. Compounding was one method of solving the problem, but the attempts hitherto made by himself to construct a gas engine with high and low-pressure cylinders, had not been successful. More experimental work upon the theoretical side of the subject was in fact required before the problem could be successfully attacked and solved, and Mr. Clark gave details of his own researches relating to the temperatures and specific heats of the working fluid used in gas engines. By means of a valve attachment to an ordinary gas engine, by which the exhaust could be closed at will, a number of cooling curves were obtained for the residual gases contained after the explosion in the cylinder of this engine and by somewhat troublesome calculations from these curves, the apparent specific heats of the gases were obtained.

The figures showed an increase of specific heat by fifteen per cent between 0 degree and 1,000 degrees centigrade, and an increase of twenty per cent between 0 degree centigrade and 1,500 degrees centigrade.

The discussion upon Mr. Clark's paper was chiefly interesting for the comments made by various speakers upon the disastrous failure of the large gas-engine plant at Johannesburg in South Africa. This plant was a most notable experiment in the application of gas engines to the work of a large electric power supply station, and its failure to comply with the conditions of the service has shaken the faith of electrical engineers in the large gas engine.

Dr. Hele-Shaw, who had visited the Johannesburg station and inspected the engines, attributed the failure to the differences between the conditions of work in Germany and in South Africa, and not to any faults or defects in the engines themselves. Chief of these differences were the poor quality of the Transvaal coal, and the low barometric pressure. Mr. Clark considered the failure due to a too bold step forward in gas-engine work, and prophesied that at no very distant date gas engines would be successfully applied to the driving of large electricity stations.

THE PUPIN METHOD OF WORKING TRUNK TELEPHONE LINES, BY SIR WILLIAM PREECE.

In this paper Sir William Preece described the history of the attempts to im-

prove long-distance telephonic communication, and the final outcome of these, namely: Pupin's system of inserting electromagnetic coils at fixed points in the telephonic cable. There is no necessity to describe Pupin's method or apparatus to American readers. But Sir William's paper and the discussion upon it contained some facts which may be new. As regards the size and number of the coils, the author stated that the size of coils and the distance apart is purely a question of experiment. It varies with every circuit and ranges between one and two miles. In fact, the solution of the problem is a case of experience and compromise. Sir John Gavey has obtained the best results with coils at every two miles, J. J. Carty at every one and one-quarter miles on long lines, but at every three-quarters of a mile on short lines. The former gets better results with no iron core, the latter prefers fine iron-wire as a core. Mr. Gill, of the National Telephone Company, places them at every mile and uses iron cores. These coils are inserted in iron cylinders filled with resin oil and buried.

Referring to the greater range of speech, Sir William Preece remarked that the use of loaded lines is increasing rapidly. The equivalent range of speech has been increased in one case from sixty-six to 176 miles. This is an instance of an underground cable. Although in Germany they have found the ratio to be as 1:4, in America it is thought that 1:3 is the outside commercial limit, and in Great Britain we find the range of a loaded line is 2.4 times that of an unloaded one.

Sir William Preece stated that the lower range of distance at which speech is possible in the United Kingdom, as compared with Germany and the United States, is altogether due to the much damper climate, which renders the leakage factor much higher.

In the discussion upon this paper, Sir Oliver Lodge pointed out that Oliver Heavyside had years ago predicted the advantages of using self-induction as an aid in telegraphic and telephonic communication, and that Professor Pupin had thus supplied the practical means for carrying out Mr. Heavyside's ideas. S. Brown referred to the difficulties caused by splitting up the induction blocks or coils, as in Pupin's system, and stated that the continuous application of induction all along the line of cable was to be preferred on many grounds. There were three methods of effecting this, and perhaps the most promising was that in which a twisted cable of iron and copper was employed.

If the permeability of iron could be raised sixfold, Mr. Brown stated that in his opinion it would be quite possible to construct a cable which would allow telephonic communication between London and New York. In closing the discussion Professor Thompson referred to the prejudice of the submarine cable companies against the use of anything resembling an induction coil in connection with their cables, and stated that his suggestion of the use of inductive leaks was made in deference to this prejudice. There were still great possibilities open in submarine cable work, for the rate of transmission was, even now, only one-tenth of that in regular use on land lines.

NOTE ON AN OSCILLOGRAPHIC STUDY OF DUDDELL ARCS OF LOW FREQUENCY, BY J. T. MORRIS.

The author stated that the work of Mrs. Ayrton, and of Blondel, Duddell and Simon upon alternating and direct-current arcs was well known, and that the experiments of which the results were recorded in his paper were carried out in order to study at low frequencies the several factors which contribute to the successful operation of the Poulsen arc.

The chief objects were to study the effects of the medium in which the arc was burning, and the effects of a transverse magnetic field. In no case were frequencies of more than 1,000 used in the experiments. The fact that an arc is more easily extinguished when burning in coal gas than when burning in air has recently been turned to account in more ways than one—notably in the Poulsen arc and in certain forms of interrupter for induction coils, as in that known as the "moto-magnetic" interrupter.

In the author's experiments upon this subject, the arc was struck between horizontal carbon electrodes of twelve millimetres diameter and the length of the arc was adjusted to one millimetre. The alternating current used had a frequency of sixty. The results obtained show that the approximate resistance when the arc is started in air is 500 ohms, while in coal gas it is 6,000 ohms. The experiments were repeated in the two gases with a transverse magnetic field of about 3.330 centimetre-gramme-seconds units; the experiments in this case being carried out in a mica walled enclosure, through which the air or coal gas was passed. The magnetic field produced the characteristic jets of yellow flame when the arc was struck in air, with the usual noise, but in coal gas the jets of flame were absent.

Other experiments were made using a copper positive pole and a carbon negative pole, in air and coal gas, with pulsating direct-current arcs; and also using aluminum for the electrodes and amyl-acetate as the medium in which the arc was struck. Finally, the production of regular pulsations in direct-current arcs by means of a magnetic field was studied, it having been noted by other observers, when a direct-current arc is suddenly extinguished by the application of a transverse magnetic field, that it goes out with what may be called a shriek or wail. This fact suggested to the author that the current through the arc was pulsating, and so, after some preliminary experiments, the following arrangement was devised. The previous horizontal arrangement of carbons was used, but in this case the carbons were beveled on their upper sides at their extremities, so that the projection of each carbon in a vertical plane formed an angle of forty degrees with the horizontal. When an arc was struck between these electrodes at a pressure of 480 volts direct current, having a non-inductive resistance in series, the current through the arc pulsated with a frequency which was higher the stronger the magnetic field in which it was burning.

Possibly, by correctly adjusting the field, this action might be made use of to intensify the oscillation produced in an oscillatory circuit connected to it, but these experiments must only be regarded as preliminary. It should be noted that as far as the evidence in the author's experiments goes, it was not possible to preserve oscillations of constant frequency for more than half a minute at a time. An examination of the arc showed that on the positive pole the arc formed a number of separate glowing spots in a vertical plane, while the negative electrode had a much shorter but continuously bright line. This effect was reversed when both poles and field were reversed.

NOTES UPON TUNING IN WIRELESS TELEGRAPHY, BY SIR OLIVER LODGE.

The author described the essential differences in the electrical impulses desired for sending the ether or Hertzian waves from tuned and untuned stations, and stated that in his work upon the subject he had operated only with small powers, and at distances up to 300 miles. The aim of the operator in tuned work was to obtain an oscillation of high frequency with steep curves, as opposed to the low frequency and sloping curves desired for untuned work. This effect could be obtained by the use of points in the place of knobs for the spark-gap, and by other

modifications of the signaling apparatus. As regards the aerials for tuned work, it has been found that the best results were obtained when these take the form of two horizontal wire frames, entirely insulated from the ground, the greater the distance separating the lower of these from the ground the better being the results as regards tuning. The arc was formed in the usual manner between these two aerials. By the use of an adjustable condenser capacity, inside the receiving station, it was possible to deaden the receiving apparatus to all waves except the upper portions or peaks of those transmitted; the whole of the lower portions of the waves being damped out. In this manner all signals save those sent from the tuned stations are eliminated, and although much energy is wasted, the receiving apparatus is sufficiently sensitive to record signals at 300 miles distance, with a plant of only one horse-power at the transmitting station. An experimental demonstration of the Lodge and Muirhead system is now at work on the south coast of England, between Elmer's End and Hythe.

Sir William Preece, Professor Trowton, L. L. Price and Mr. Hawksley, joined in the discussion. Sir William Preece did not agree with Professor Lodge's statement regarding the necessity for insulation from the earth's charge in wireless work; but the author pointed out in reply that although in ordinary work, as for instance, that of Marconi, this insulation from the earth was not necessary—in tuned work upon the lines described in his paper, it was absolutely essential, since peaked oscillations of high frequency could not be obtained without it.

THE ORIGIN AND PRODUCTION OF CORRUGATION OF TRAMWAY RAILS, BY W. WORBY-BEAUMONT.

That which is known as "corrugation" of the surface of tramway rails has given rise to much speculation and some investigation concerning its cause. Although known as corrugation, it is hardly perceptible as of a form usually understood when so described. It consists of an approximately regular alternation of hard and soft, or of hard and less hard patches of the surface rolled by the tram-car wheels. The surface of the hard patches is very slightly higher than the general surface, but it becomes sufficiently high to declare its existence by the noise made by the tram-car wheels, as they roll along the rails as though running over a rack with teeth of almost no assignable height.

Corrugation declares itself variously as to time of its appearance after a rail is first used, and as to position of rail somewhat differently in different towns, but it has become general since the introduction of electrically propelled tram-cars, and particularly since the appearance of the latter-day heavy cars. It is the cause of considerable annoyance—and also considerable expense is incurred in grinding down the raised hard prominences, by emery grinding blocks.

CALCIUM: ITS PROPERTIES AND POSSIBILITIES, BY ARTHUR E. PRATT.

Calcium is now being prepared in increasing quantities by electrolysis of the fused chloride and fluoride, therefore the following account of its characteristics and properties is of some interest to electrical engineers:

Calcium is a silvery white metal readily oxidized in moist air. It is very light (specific gravity 1.52), fairly malleable, has a high specific heat, and is a good conductor of electricity. It is about as hard as aluminum, but at 400 degrees centigrade becomes as soft as lead. It is volatile, and can be sublimed in vacuo between 700 degrees centigrade and 800 degrees centigrade, and melts at the latter temperature. It is a very powerful reducing agent.

The chief effects of alloying calcium with other metals are to produce brittleness, crystallization and hardness; to promote oxidization and disintegration on exposure to air; to confer the power of decomposing water and in other ways increasing the chemical activity.

The author's experiments confirm Roberts-Austen's observation that the presence of small amounts of metals of high atomic volume will cause deterioration of the physical properties of metals of low atomic volume. The atomic volume of calcium is high (25.4) and the effect of small amounts on other metals is decidedly prejudicial, provided that the metals in question are pure. The experiments were conducted in a converse manner to Roberts-Austen's, *i. e.*, the constant was a metal of high atomic volume (calcium) instead of being low (gold). In the course of the work the following observations were made. When an alloy is made of calcium and some metal which possesses a chemical property in common with it, an increased activity in the manifestation of that property is noticed in the alloy. This increase appears to be greater than would be obtained by the simple admixture of a more active metal, the presence of calcium usually increasing the activity of the other metal. In some cases the alloy is more active than either of its constituents.

Further, the chemical properties of calcium appear to be more pronounced in an alloy with a metal having an atomic volume closely approaching that of calcium, than they are in an alloy of the same percentage with a metal having a much lower atomic value. The two metals in question should be about equally active when unalloyed, in the particular property with respect to which they are to be compared.

It is probable that both these principles are general, and not confined to calcium, although more extended research on these lines would be desirable.

The most promising applications of calcium are as a reducing agent and for the refining of metals. In the latter case it acts in three distinct ways: (1) By reducing oxides and sulphides; (2) by eliminating dissolved gases; (3) by forming compounds with certain impurities, thus rendering them less deleterious. All three modes of action are strikingly shown in the case of copper. A suitable addition of calcium will remedy "dry" or "sulphury" copper, give a sound casting, and give a soft and tough ingot with prohibitive proportions of bismuth or antimony, besides restoring ordinary overpoled copper to tough pitch. If excess of calcium be present, however, it induces brittleness on its own account.

With one or two doubtful exceptions, no alloy of calcium has shown any promise of commercial utility so far as physical properties are concerned, its only likely application in this direction being its hardening property.

Wireless Message to Alaska.

Arrangements have been completed whereby the War and Navy departments will cooperate in the maintenance of wireless communication between Nome and St. Michael, Alaska, and Seattle and San Francisco. The signal corps of the army now has wireless stations at the Alaskan cities, and next year will establish one at Fort Gibbon, which will be capable of communicating with a naval wireless station to be erected at Valdez. The navy already has several stations in Alaska.

The steel towers which the signal corps is to erect at Fairbanks and Circle, Alaska, to carry wireless telegraph instruments, will be 175 feet high. The distance between the two places is 140 miles, and regular wireless communication is to be maintained.

The Fremont Power Company Development.

By C. M. Hyskell.

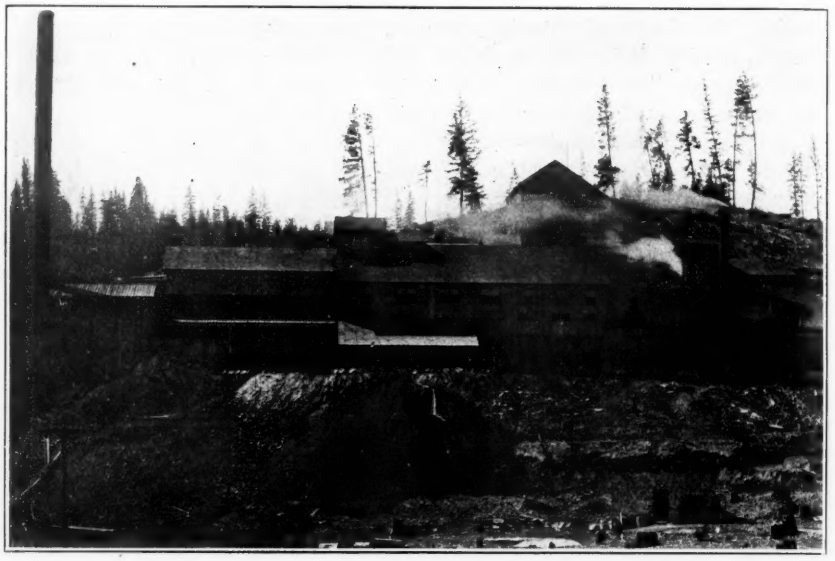
IN the Blue Mountain foothills, twenty miles west of Sumpter, Ore., an electric power plant is being completed and will be in operation September 1, to furnish power for the quartz mills of that region and supply light and power to Baker City, the metropolis of the region. The development is made by the Fremont Power Company, under the management of John Thomsen. The president and principal backer is Ray Nye, an Omaha business man.

The company owns two reservoirs known as Olive Lake and Upper Reservoir, with a combined storage capacity of 300,000,000 cubic feet, fed by Lost Creek and Lake Creek, mountain streams, which have a watershed of about sixteen to twenty square miles.

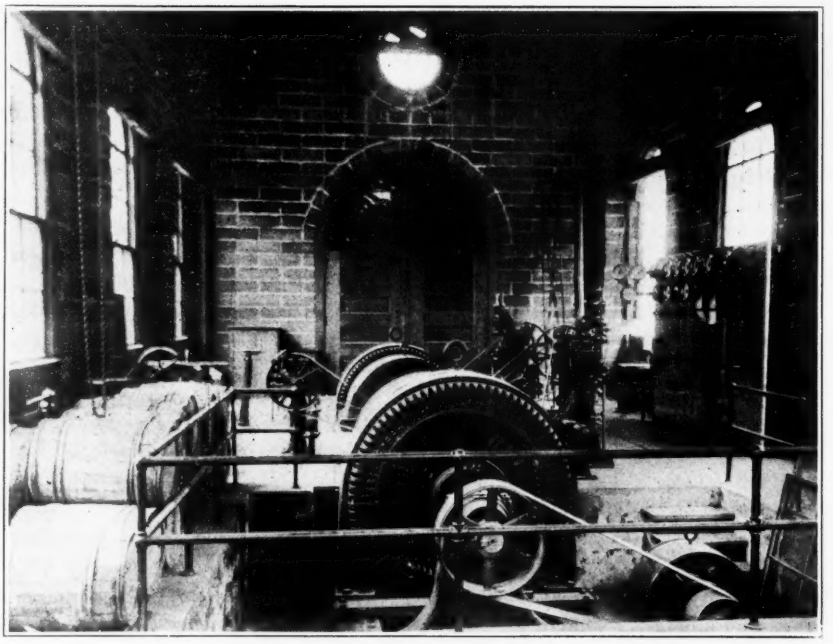
Five and one-half miles of wooden pipe and one-half mile of steel pipe, starting at the reservoir with thirty-three and one-half inches diameter and ending at the plant with a diameter of twenty inches, leads the water from the reservoirs to the wheels. The fall from the lakes to the wheels is about 1,100 feet. The difficulty of transportation of heavy iron pipe has made it necessary to use wooden pipe, made of staves and put together on the ground it passes over. The stave pipe is held together with steel bands. The maximum pressure will be about 400 feet head in the wooden pipe. The steel pipe is from one-quarter to seven-sixteenths-inch thick, lap-welded, smooth inside, having extra heavy gas hubs for lead joints. All pipes are laid in trenches sufficiently deep to prevent freezing, and air valves for the automatic ingress and egress of air are placed at all summits on the pipe-line. Blow-off valves are placed at all depressions so that the pipe can be quickly emptied if necessary.

The power plant, located at the forks of Congo Creek, a mile west of the Red Boy mine hoist house, is built of concrete blocks, made on the ground, and is thirty by sixty feet. The roof is of corrugated iron supported by rafters and purlines resting on heavy timbered trusses with four-inch beaded ceiling between. The floor is concrete, and the building is practically fireproof.

While but two generator sets are installed at the present time, foundations and water-wheel connections have been put in for a third set, which can be done without closing down the plant. The machinery consists of two 550-kilowatt, 600-revolutions-per-minute, 6,600-volt, three-phase, revolving-field Westinghouse generators, each driven by a separate 1,100-horse-power Pelton water-wheel with cast-steel discs and buckets and combined needle and deflecting nozzles. The water-wheels and generators are placed below the general level of the power-house floor, so that when the nozzles are deflected off of the wheels the stream will pass out from under the power-house without striking anything, and the use of baffle plates will be avoided. All fittings connecting



SUMPTER SMELTER, ONE OF THE SEVERAL LARGE PLANTS TO BE OPERATED WITH CURRENT FROM THE FREMONT POWER COMPANY DEVELOPMENT.



INTERIOR OF GENERATING PLANT, FREMONT POWER COMPANY.

the water-wheels with the pipe-line are of cast steel. Steel pipe, wheel nozzles and connections will be protected from water-ram by a Lombard water-balanced relief valve capable of discharging the full capacity of the pipe-line. Each generator is provided with a separate twenty-five-kilowatt exciter, which capacity is sufficient to furnish excitation current for both generators when operating at full load.

A switchboard of five panels of Blue Vermont marble seven and one-half feet long and two feet wide is arranged in the following order: Panel A on the left is the exciter panel, and mounted thereon are two ammeters for determining the amount of excitation current, voltmeter, switches, etc. Panels B and C are generator panels, upon which are mounted both alternating-current and direct-current ammeters and synchronizing outfit, oil-break switch, etc. Panel D is the load panel, with one Westinghouse graphic polyphase recording wattmeter, one Westinghouse graphic recording voltmeter, one type F Westinghouse polyphase indicating wattmeter, one static ground detector outfit, one Tirrill voltage regulator. Panel E is the feeder panel, upon which are mounted two three-pole, single-throw automatic oil-break circuit-breakers, thus providing for two separate feeder circuits. All the high-tension switches are located in a manhole underneath the switchboard and can be operated from the board by bell cranks and levers. An eight-ton hand-power traveling crane is used for handling the machinery in the power-house.

The present capacity of the plant is 2,000 horse-power, and the cost to date has been $500,000.

A transmission line is being built with much difficulty over the mountains from the plant *via* Lawton, Granite Creek, Monumental mine, Cable Grove and Columbia mine, to a point near Bourne. The line will be completed to this point by September 1, after which it will be continued five miles further to the city of Sumpter. Power will be transmitted at 20,000 volts to Bourne, where there will be located a lowering transformer station with secondary taps for 1,100 to 2,200 volts.

ERECTING TRANSMISSION LINE FOR THE FREMONT POWER COMPANY DEVELOPMENT.

For lightning protection there will be placed at each end of the line, on the high-tension side, three low-equivalent lightning arresters mounted on marble slabs with insulators, etc.; three oil-insulated, self-cooling choke-coils of twenty amperes capacity, with insulators and all necessary auxiliaries, and disconnecting switches.

The line is being built with tamarack poles thirty-five feet in length. The present circuit will consist of three No. 4 B. & S. gauge hard-drawn copper wires spaced four centres. The insulators are triple petticoat Lima porcelain for 45,000 volts, and will be tested to 80,000 volts. The insulators will be fastened to the cross-arms by one-and-one-eighth-inch composite iron pins.

THE BRITISH ASSOCIATION.[1]

BY SILVANUS P. THOMPSON.

(*Concluded.*)

FIFTY YEARS LATER.

Fifty years have fled, and Hunt, Grove, Smee, Tyndall, Cowper, Joule, Bidder and Stephenson have long passed away. Lord Kelvin remains the sole and honored survivor of that remarkable symposium. But the electric motor is a gigantic practical success, and the electric motor industry has become a very large one, employing thousands of hands. Hundreds of factories have discarded their steam engines to adopt electric-motor driving. All traveling cranes, nearly all tram-cars, are driven by electric motors. In the navy and in much of the merchant service the donkey engines have been replaced by electric motors. Electric motors of all sizes and outputs, from one-twentieth horse-power to 8,000 horse-power, are in commercial use. One may well ask: What has wrought this astonishing revolution in the face of the unanimous verdict of the engineers of 1857?

The answer may be given in terms of the action and reaction of pure and applied science. Pure science furnished a discovery; industrial applications forced its development; that development demanded further abstract investigation, which in turn brought about new applications. It was beyond all question the development of the dynamo for the purposes of electrotyping and electric light which brought about the commercial advent of the electric motor. For about that very time Holmes and Siemens and Wilde and Wheatstone were at work developing Faraday's magnetoelectric apparatus into an apparatus of more practical shape; and the electric lighthouse lamp was becoming a reality, which Faraday lived to see before his death in 1867. That eventful year witnessed the introduction of the more powerful type of generator which excited its own magnets. And even before that date a young Italian had made a pronouncement which, though it was lost sight of for a time, was none the less of importance. Antonio Pacinotti in 1864 described a machine of his own devising, having a specially wound revolving ring-magnet placed between the poles of a stationary magnet, which, while it would serve as an admirable generator of electric currents if mechanically driven, would also serve as an excellent electric motor if supplied with electric currents from a battery. He thereupon laid down the prin-

[1] Address by the president of the Engineering Section, British Association for the Advancement of Science, Leicester, England, August 1, 1907.

ciple of reversibility of action—a principle more or less dimly foreseen by others, but never before so clearly enunciated as by him. And so it turned out in the years from 1860 to 1880, when the commercial dynamo was being perfected by Gramme, Wilde, Siemens, Crompton and others, that the machines designed specially to be good and economical generators of currents proved themselves to be far better and more efficient motors than any of the earlier machines which had been devised specially to work as electromagnetic engines. Moreover, with the perfection of the dynamo came that cheap source of electric currents which was destined to supersede the battery. That a dynamo driven by a steam engine furnishing currents on a large scale should be a more economical source of current than a battery in which zinc was consumed does not appear to have ever occurred to the engineers who in 1857 discussed the feasibility of electric motive power. Indeed, had any of them thought of it they would have condemned the suggestion as chimerical. There was a notion abroad—and it persisted into the '80's—that no electric motor could possibly have an efficiency higher than fifty per cent. This notion, based on an erroneous understanding of the theoretical investigations of Jacobi, certainly delayed the progress of events. Yet the clearest heads of the time understood the matter more truly. The true law of efficiency was succinctly stated by Lord Kelvin in 1851, and was recognized by Joule in a paper written about the same date. In 1877 Mascart pointed out how the efficiency of a given magnetoelectric machine rises with its speed up to a limiting value. In 1879 Lord Kelvin and Sir William Siemens gave evidence before a parliamentary committee as to the possible high efficiency of an electric transmission of power; and in August of the same year, at the British Association meeting at Sheffield, the essential theory of the efficiency of electric motors was well and admirably put in a lecture by Professor Ayrton. In 1882 the present author designed, in illustration of the theory, a graphic construction, which has been ever since in general use, to make the principle plain. The counter electromotive force generated by the motor when running, which Hunt and Tyndall deplored as a defect, is the very thing which enables the motor to appropriate and convert the energy of the battery. Its amount relatively to the battery's own electromotive force is the measure of the degree to which the energy which would otherwise be wasted as heat is utilized as power. Pure science stepped in then to confirm the possibility of a high efficiency in the electric motor *per se*. But pure science was also brought into service in another way. An old and erroneous notion, which even now is not quite dead, was abroad to the effect that the best way of arranging a battery was so to group its component cells that its internal resistance should be equal to the resistance of the rest of the circuit. If this were true, then no battery could ever have an efficiency of more than fifty per cent. It was supposed in many quarters that this misleading rule was applicable also to the dynamo. The dynamo makers discovered for themselves the fallacy of this idea, and strove to reduce the internal resistance of the armatures of their machines to a minimum. Then the genius of the lamented John Hopkinson led him to apply to the design of the magnetic structure of the dynamo abstract principles upon which a rational proportioning of the iron and copper could result. A similar investigation was independently made by Gisbert Kapp, and between these accomplished engineers the foundations of dynamo design were set upon a scientific basis. To the perfection of the design the magnetic studies of our ex-president, Professor Ewing, contributed a notable part, since they furnished a basis for calculating out the inevitable losses of energy in armature cores by hysteresis and parasitic currents in the iron when subjected to recurring cycles of magnetization. Able constructive engineers, Brown, Mordey, Crompton and Kapp, perfected the structural development, and the dynamo within four or five years became, within its class, a far more highly efficient machine than any steam engine. And as by the principle of reversibility every dynamo is also capable of acting as a motor, the perfection of the dynamo implied the perfection, both scientific and commercial, of the motor also. The solution in the '80's of the problem how to make a dynamo to deliver current at a constant voltage when driven at a constant speed found its counterpart in the solution by Ayrton and Perry of the corresponding problem, how to make a motor which would run at constant speed when supplied with current at a constant voltage. Both solutions depend upon the adoption of a suitable compound winding of the field magnets.

A little later alternating currents claimed the attention of engineers, and the alternating-current generator, or "alternator," was developed to a high degree of perfection. To perfect a motor for alternating currents was not so simple a matter. But again pure science stepped in, in the suggestion by Galileo Ferraris of the extremely beautiful theorem of the rotatory magnetic field, due to the combination of two alternating magnetic fields equal in amplitude, identical in frequency and in quadrature in space, but differing from each other by a quarter-period in phase. To develop on this principle a commercial motor required the ingenuity of Tesla and the engineering skill of Dobrowolsky and of Brown; and so the three-phase induction motor, that triumph of applied science, came to perfection. Ever since 1891, when at the Frankfort Exhibition there was shown the *tour de force* of transmittting 100 horse-power to a distance of 100 miles with an inclusive efficiency of seventy-three per cent, the commercial possibility of the electric transmission of power on a large scale was assured. The modern developments of this branch of engineering and the erection of great power stations for the economic distribution of electric power generated by large steam plants or by water-turbines are known to all engineers. The history of the electric motor is probably without parallel in the lessons it affords of the commercial and industrial importance of science.

But the query naturally rises, If a steam engine is still needed to drive the generator that furnishes the electric current to drive the motors, where does the economy come in? Why not use small steam engines, and get rid of all intervening electric appliances? The answer, as every engineer knows, lies in the much higher efficiency of large steam engines than of small ones. A single steam engine of 1,000 horse-power will use many times less steam and coal than a thousand little steam engines of one horse-power each, particularly if each little steam engine required its own little boiler. The little electric motor may be designed, on the other hand, to have almost as high an efficiency as the large motor. And while the loss of energy due to condensation in long steam pipes is most serious, the loss of energy due to transmission of electric current in mains of equal length is practically negligible. This is the abundant justification of the electric distribution of power from single generating centres to numerous electric motors placed in the positions where they are wanted to work.

EDUCATION AND TRAINING OF ENGINEERS.

Interplay of action and reaction make for progress, not only in the evolution of the scientific industries, but also in the development of the individual engineer. In him, if his training is on right lines,

pure theory becomes an aid to sound practice; and practical applications are continually calling him to resort to those abstractions of thought, the underlying principles, which, when known and formulated, are called theories. Recent years have brought about a so much better understanding of education, in its bearing upon the professions and constructive industries, that we now seldom hear the practical man denouncing theory, or the theorist pooh-poohing practice. It is recognized that each is useful, and that the best uses of both are in conjunction, not in isolation. As a result of this better understanding distinct progress is being made in the training of engineers. Of this the growth of the engineering departments of the universities, and of the technical colleges and schools, affords striking evidence. The technical schools, moreover, are recognizing that their students must have a sound preliminary education, and are advancing in the requirements they expect of candidates for admission. They are also finding out how their work may best supplement the practical training in the shops, and are improving their curricula accordingly. In the engineering industry, too, Great Britain is slowly following the lead taken in America, Germany and Switzerland, in the recognition afforded to the value of a systematic college training for the young engineer, though there is still much apathy, and even distrust, shown in certain quarters. Yet there is no doubt that the stress of competition, particularly of competition against the industry and the enterprise of the trained men of other nations, is gradually forcing to the front the sentiment in favor of a rational and scientific training for the manufacturer and for the engineer. As William Watson, in his "Ode on the Coronation," wrote in a yet wider sense of England:

> For now the day is unto them that know,
> And not henceforth she stumbles on the prize;
> And yonder march the nations full of eyes.
> Already is doom a-spinning. . . .

Truly the day is "unto them that know." Knowledge, perfected by study and training, must be infused into the experience gained by practice; else we compete at very unequal odds with the systematically trained workers of other nations. Nor must we make the mistake here in the organization of our technical institutions of divorcing the theory from its useful applications. In no department is this more vital than in the teaching of mathematics to engineering students. For while no sane person would deny that the study of mathematics, for the sole sake of mathematics, even though it leads to nothing but abstract mathematics, is a high and ennobling pursuit, yet that is not the object of mathematical studies in an engineering school. The young engineer must learn mathematics not as an end in itself, but as a tool that is to be useful to him. And if it is afterward to be of use to him, he must learn it by using it. Hence the teacher of mathematics in an engineering school ought himself to be an engineer. However clever he be as a mathematical person, his teaching is unreal if he is not incessantly showing his learners how to apply it to the problems that arise in practice; and this he is incapable of doing if these problems do not lie within his own range of experience and knowledge. Were he a heaven-born senior wrangler, he is the wrong man to teach mathematics if he either despises or is ignorant of the ways in which mathematics enter into engineering. The fact is, that for the great majority of engineering students, the mental training they most need is that which will enable them to think in physics, in mechanics, in geometric space, not in abstract symbols. The abstract symbols, and the processes of dealing with their relations and combinations, are truly necessary to them; but they are wanted not for themselves, but to form convenient modes of expressing the physical facts and laws, and the interdependence of those physical facts and laws. When the student loses grip of the physical meaning of his equations, and regards them only as abstractions or groupings of symbols, woe betide him. His mathematics amount to a mere symbol-juggling. That is how paper engineers are made. The high and dry mathematical master who thinks it beneath him to show a student how to plot the equations $y = A \sin x$, or $r = b \sin \theta$, or who never culls an example or sets a problem from thermodynamics or electricity, must be left severely on one side as a fossil. Better a living Whitworth scholar than a dry-as-dust Cambridge wrangler. He at least knows that elasticity is something more real than the group of symbols $E = p \div \frac{\Delta c}{x}$, which any mathematician may "know," even though he be blissfully ignorant whether the force required to elongate a square-inch bar of steel by one one-millionth of its length is ten ounces or ten tons.

One evidence of the wholesome change of opinion that is springing up concerning the training of engineers is the abandonment of the system of taking premium pupils into works with no other test or qualification than that of the money-bag. Already many leading firms of engineers have been finding that the practice of taking sons of wealthy parents for a premium does not answer well, and is neither to their own advantage nor, in many cases, to that of the "pupil," whom it is nobody's particular business in the shops to train. Premium pupilage is absolutely unknown in the engineering firms of the United States or on the Continent of Europe. The firms who have abandoned it are finding themselves better served by taking the ablest young men from the technical schools and paying them small wages from the first, while they gain experience and prove themselves capable of good service. Messrs. Yarrow & Company have led the way with a plan of their own, having three grades of apprenticeship, admission to which depends upon the educational abilities of the youths themselves. Messrs. Siemens have adopted a plan of requiring a high preliminary training. The Daimler Motor Company has likewise renounced all premiums, preferring to select young men of the highest intelligence and merit. Messrs. Clayton and Shuttleworth have quite recently reconstructed their system of pupil-apprenticeship on similar lines. The British Westinghouse Company and the British Thomson-Houston Company have each followed an excellent scheme for the admission of capable young men. Even the conservatism of the railway engineers shows signs of giving way; for already the Great Eastern Railway has modernized its regulations for the admission of apprentices. What the engineering staffs of the railway companies have lost by taking in pupils because of their father's purses rather than for the sake of their own brains it is impossible to gauge. But the community loses too, and has a right to expect reform.

To this question, affecting the whole future outlook of engineering generally, a most important contribution was made in 1906 by the publication by the Institution of Civil Engineers of the report of a committee (appointed in November, 1903) to consider and report to the council upon the subject of the best methods of education and training for all classes of engineers. This committee, a most influential and representative body, consisting of leading men appointed by the several professional societies—the Institutions of Civil, Mechanical, and Electrical Engineers, the Institution of Naval Architects,

the Iron and Steel Institute, the Institution of Gas Engineers, the Institution of Mining Engineers and two northern societies—was ably and sympathetically presided over by Sir William H. White. Its inquiries lasted over two years, and included the following sections: (1) Preparatory Training in Secondary Schools; (2) Training in Offices, Workshops, Factories, or on Works; (3) Training in Universities and Higher Technical Institutions; (4) Postgraduate work. The findings of this committee must be received as the most authoritative judgment of the most competent judges. So far as they relate to preparatory education they suggest a modernized secondary school curriculum in which there is no one specialized scientific study, but with emphasis on what may be called sensible mathematics. They also formulated one recommendation so vital that it must be quoted in full:

"A leaving examination for secondary schools, similar in character to those already existing in Scotland and Wales, is desirable throughout the United Kingdom. It is desirable to have a standard such that it could be accepted by the Institution [of Civil Engineers] as equivalent to the studentship examination, and by the universities and colleges as equivalent to a matriculation examination."

One may well wonder why such a reasonable recommendation has not long ago been carried out by the Board of Education. Perhaps it has been too busy over the religious squabble to attend to the pressing needs of the nation.

The second set of recommendations relates to engineering training. It begins with the announcement that "long experience has led to general agreement among engineers as to the general lines on which practical training should proceed;" but goes into no recommendations on this head beyond favoring four years in workshops, on works, in mines, or in offices, expressing the pious desire that part of this practical training should be obtained in drawing-offices, and suggesting that during workshop training the boys should keep regular hours, be subject to discipline, and be paid wages. It then lays down a dozen recommendations as to the "academic" training suitable for the average boy. He should leave school about seventeen; he should have a preliminary year, or introductory workshop course of a year, either between leaving school and entering college, or after the first year of college training. If the workshop course follows straight on on leaving school, there must be maintenance of studies either by private tuition or in evening classes, so that systematic study be not suspended. For the average student, if well prepared before entering college, the course should last three academic years (three sessions); in some cases this might be extended to four or shortened to two. A sound and extensive knowledge of mathematics is necessary in all branches of engineering, and those departments of mathematics which have no bearing upon engineering should not claim unnecessary time or attention. The committee strongly recommends efficient instruction in engineering drawing (necessarily given in the laboratory) in testing materials and structures, and in the principles underlying metallurgical processes. In the granting of degrees, diplomas and certificates, importance should be attached to laboratory and experimental work performed by individual students, and such awards should not depend on the results of terminal or final examinations alone.

All this is most excellent. It will be seen that it is entirely incompatible with the premium-pupil system, which may therefore be regarded as having been weighed and found wanting. For two things clearly stand out; that the young engineer must be college-trained, and that when he goes to work he should be regularly paid. It would have been well if the committee could have been more explicit as to the proper course of workshop training; for instance, as to the systematic drafting of the young engineer, through the shops—forge, foundry, pattern-shop, fitting-shop, etc., and as to the proper recognition of the duty of the shop-foreman to allocate work to the novice in suitable routine. These are doubtless among the matters in which "long experience had led engineers to general agreement." But this being so, it would have beeen well to state them authoritatively. A notable feature of this report is its healthy appreciation of the advantages of training, and an equally healthy distrust of the practice of cramming for examinations. So soon as any subject is crammed, it ceases to afford a real training. "Nature provides a very convenient safety-valve for knowledge too rapidly acquired." It is even whispered that a new species of crammer has arisen to "prepare" candidates in engineering for the graduate examinations of the Institution of Civil Engineers. The distinguished framers of this epoch-making report on the education and training of engineers at least give no countenance to any such parasitical development. For the scheme of education and training at which the committee has aimed is genuinely scientific—a happy federation of the theoretical with the practical. It seeks to place the training on a broad basis, and to secure to every future engineer worthy of the name the advantage of learning his professional work in both its aspects. It seeks, in short, to take advantage of that reflex action between science and its applications in which lies the greatest stimulus to progress. Its adoption will utilize for the young engineer, and therefore for the engineering industry as a whole, the facilities for training now so widely afforded throughout the country. If the institutions, schools, and colleges where engineering training is offered are but rightly developed and co-ordinated, the engineers of Great Britain need have no fear as to holding their own against the trained engineers of other countries. It is for the employers to make use of these institutions, and to show that sympathetic interest in their efficiency which is essential to their full success.

British and American Street Railway Statistics.

According to the British census of 1901 and the United States census of 1900, sixty-nine per cent of the entire population of the United Kingdom was urban in character, compared with 44.6 per cent in the United States. The total urban population there was 29,144,726, and here 23,850,000.

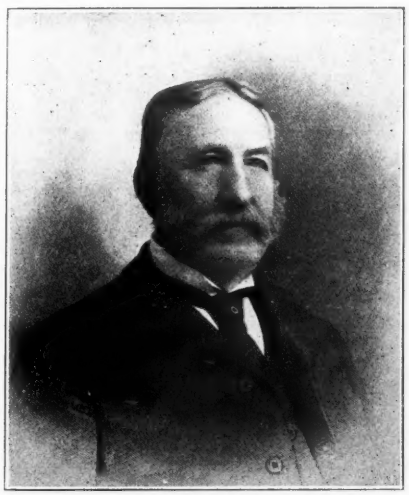
In 1902 the total length of street railway track in the United Kingdom was 2,336 miles. In the United States there were 22,328 miles of track. The urban population over there was 12,476 per mile of track, compared with 1,516 here. In 1902 British tramways carried 1,394,452,983 passengers, compared with 5,521,509,521 carried on the street railways of the United States. The average American car carried 93,585 passengers per year, as compared with 182,463 carried by each British car, showing that we are not, as a nation, more overcrowded here.

Illumination of Niagara Falls.

It is stated that the first public illumination of Niagara Falls will be given on the night of September 2, Labor Day, Forty-one projectors will be used, fifteen of which will be thirty inches in diameter, twenty-one will be eighteen inches in diameter and five will be sixteen inches in diameter. It is expected that the light from the thirty-inch projectors will be visible in Toronto and Rochester. Twenty of the projectors will be located on a large platform, 250 feet in length, in the gorge on the Canadian side, and the remainder of the battery will be located on the top of the gorge bank to sweep the upper rapids.

CANADIAN INDUSTRIAL DEVELOPMENT.

A FEW years ago the slowest-moving and most neglected of the British colonies, the Dominion of Canada to-day represents one of the most important and progressive dependencies in the world. In almost every direction in art, science, in commerce and labor, Canada has forged ahead during the last five or six years at a rate which not only taxes the imagination to picture the results, but which has created statistics which are almost unbelievable. Taking 1881, the date of the incorporation of the Canadian Pacific Railway, as the starting point for an industrial upbuilding, we find that the population at that time was 4,324,810. This is now placed at 5,766,606. In 1881 there were thirty-five towns



MR. C. F. SISE, PRESIDENT OF BELL TELEPHONE COMPANY OF CANADA.

with a population of 5,000 or over, the aggregate of these thirty-five towns being about 660,000. In 1906 there were sixty-two large towns with an aggregate population of 1,330,000. Emigration from Great Britain, and, indeed, from the United States, is increasing, some 150,000 immigrants having entered the Dominion during the first six months of the present year.

It was not long ago that lumbering was the chief industry and lumber the most extensive export of the Dominion. This is still an important item, but it has been eclipsed by the quantity of farm produce exported. This, of course, is significant of the development of the country. What was forest is now being turned into cultivated land. The total exports in 1898 amounted to $164,150,000. In 1906 they had increased to $256,586,000.

Canada is rich in all the natural resources that go to make up the prosperous country. The principal mineral resources are coal, gold, iron, petroleum, asbestos, copper, silver and nickel.

The value of land in Canada has increased remarkably. The advance in price of Hudson Bay shares illustrates the appreciation in the value of the prairie land in the Dominion. The Hudson Bay Company is the largest land owner, next to the Canadian Pacific Railway, in the country. In 1881 these shares were worth about twenty. In 1902 the price was thirty-seven; in 1904 it rose to fifty-four, and in 1906 it touched 129.

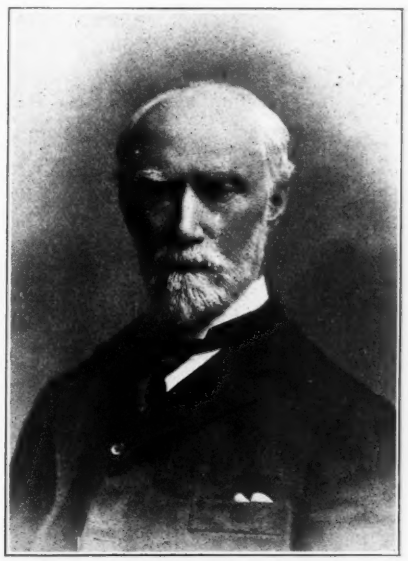
Another natural source of wealth in which Canada takes a unique position is its unparalleled water-power possibilities. Quebec is supplied with power from waterfalls near at hand; Montreal with power developed at Shawinigan and Chambly; Ottawa from falls near at hand; Toronto, Hamilton and other Ontario towns with power radiating from Niagara Falls; Port Arthur by power developed on the Kamanistiquia river; Winnipeg by power developed from Lac du Bonnet, and Calgary by power from the Bow river. Vancouver and Victoria, on the Pacific coast, are supplied by hydraulic developments near to each city. And here and there in the territory between are great natural watersheds, immense divides, valleys and drainage areas which make the forecast possible that the time may come when every wheel in the Dominion will be turned through power developed by some form of electrical generator.

As an indication of the immense hydroelectric development and possibilities, the conditions in a comparatively restricted area may be pointed out. In the Niagara district, according to figures taken from the report of the Hydroelectric Power Commission of the Province of Ontario, the Hamilton Cataract Power, Light and Traction Company has a maximum capacity for 29,000 horse-power; the Canadian Niagara Power Company, 100,000 horse-power; the Electrical Development Company of Ontario, Limited, 125,000 horse-power, and the Ontario Power Company, 180,000 horse-power.

Going further west and to the north, there is available, according to the same source of information, a minimum twenty-four-hour horse-power on the Moira river and its tributaries of 4,900; on the upper Trent river, 17,265; on the lower Trent river, 43,510; in the Lake Huron and Georgian Bay district, 59,503 horse-power; in the Ottawa valley and St. Lawrence river district, 1,421,366 horse-power, and in the Algoma, Thunder Bay and Rainy river district, 359,119 horse-power.

In the well-settled cities electrical developments have gone forward at a rapid rate. Not only are immense amounts of power used for traction and lighting purposes, but the motor loads of the various central stations form no small part of the total demand.

One of the earliest electrical developments of the Dominion was the Bell Telephone Company of Canada. This was incorporated in 1880 under a special act.



MR. H. P. DWIGHT, PRESIDENT OF THE GREAT NORTHWESTERN TELEGRAPH COMPANY.

The company operates in the provinces of Quebec, Ontario, Manitoba, Alberta, Saskatchewan and the territories. Its capital stock issued is $9,980,800. In 1906 there were 95,145 subscribers, 571 exchanges, 1,160 agencies, 9,391 miles of poles, and 43,400 miles of wire. The officers and directors are C. F. Sise, president; Hon. Robert Mackay, vice-president; W. G. Slack, secretary and treasurer; F. P. Fish, W. R. Driver, R. Archer, Charles Cassils, Hugh Paton, Thomas Sherwin and H. D. Warren.

Of course, in point of time the first electrical development was the telegraph. This is now represented in the Dominion principally by the Great Northwestern Telegraph Company of Canada. The capital invested in this company and in the companies, the lines of which are leased, is $3,800,000. The company has 1,500 telegraph stations in the Dominion. The total mileage is 18,000, and there are 35,-

000 miles of wire. The officers are H. P. Dwight, president; I. McMichael, vice-president and general manager; George D. Perry, secretary-treasurer; A. C. McConnell, auditor.

In learning, the Dominion has advanced at the same rate as in industry. Notable among the institutions for the advancement of science and art is McGill University, situated at Montreal, and it is particularly gratifying to realize that this grand institution was reared and has been fostered by men who made their mark and achieved their fortunes in the Dominion.

The Canadian Westinghouse Company, Limited, Hamilton, Ontario.

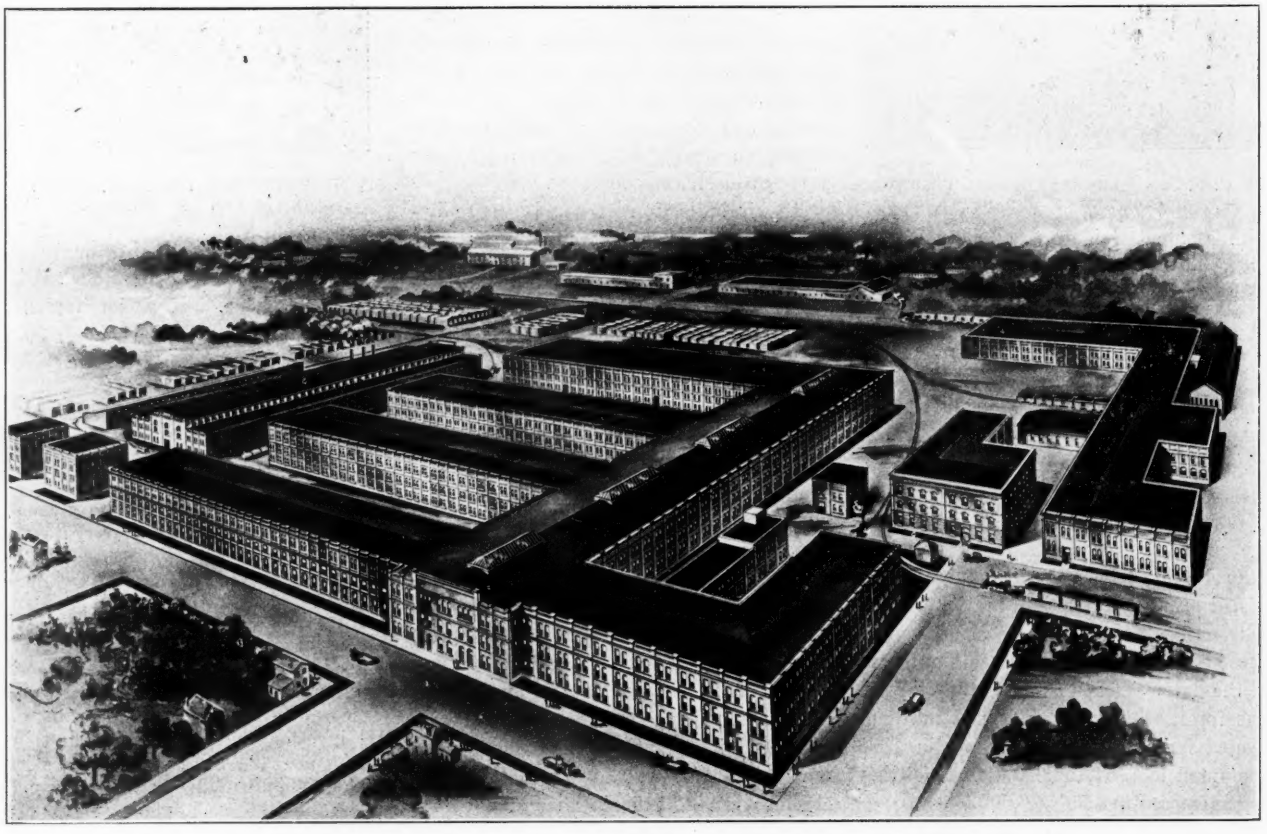
THE name Westinghouse has a world-wide significance in the industrial field. Representing the most solid elements of modern enterprise and progress, the Canadian Westinghouse Company, Limited, of Hamilton, Ontario, is one of the prominent examples of Canadian business development. The Canadian organization is quite distinct from the American concern, considerable Canadian as well as Westinghouse capital being invested in the enterprise. The board of directors consists of the following: George Westinghouse, George C. Smith, L. A. Osborne, W. Y. Soper, C. F. Sise, H. H. Westinghouse, Thomas Ahearn, P. J. Myler, Hon. J. M. Gibson and Charles A. Terry. The officers are: president, George Westinghouse; first vice-president, H. H. Westinghouse; second vice-president, L. A. Osborne; third vice-president, general manager and treasurer, Paul J. Myler; secretary, John H. Kerr; manager of works, F. A. Merrick. The head office of the company is, of course, in Hamilton, and sales offices are established in Toronto, Montreal, Halifax, Winnipeg and Vancouver.

MR. PAUL J. MYLER, VICE-PRESIDENT AND GENERAL MANAGER, CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

The air-brake department, which was started as a manufacturing plant in Canada about eleven years ago, has been consolidated with the electrical department in the Canadian company, the old air-brake works being left intact. The agreement with the Pittsburg company places at the disposal of the Canadian concern all the inventions and designs of the former.

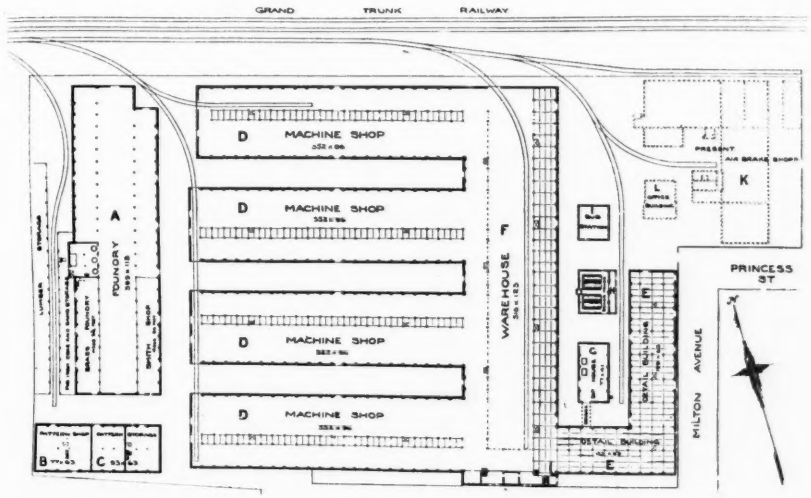
The lines of manufacture include alternating and direct-current generators and motors, controllers, transformers, switches and switchboards, rheostats, measuring instruments, arc lamps and various subsidiary products.

In laying out the yards and buildings



BIRD'S-EYE VIEW OF THE WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

and in the design of the buildings provision has been made for systematic handling of material and for extensions when these may become necessary. This has been facilitated by the adoption of complete electrical drive for the plant, the freedom from the necessity of grouping the buildings around a central station with mechanical transmission giving considerable flexibility to the design of the works. The warehouse, which may be considered the central building of the works, runs north and south, a small machine shop wing projecting to the east end, and a larger machine shop wing to the west. At the immediate end of the large machine shop are the foundry, pattern shop and pattern-storage shop. To the east of the warehouse are the boiler house, the insulation building and the substation. Somewhat detached and to the northeast are the office building and the air-brake plant. This layout will be understood from a study of the accompanying ground plan.



GROUND PLAN OF THE WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

Raw material is brought into the yards and the finished product shipped out on railway sidings. Throughout the yard and buildings the material is handled by an industrial railway of twenty-four-inch gauge, and also by traveling and jib cranes, the motive power for the industrial railway consisting of storage-battery

VIEW OF LARGE MACHINE AISLE IN THE WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

locomotives, designed and built by the company.

The buildings are of concrete and brick, the foundations and walls to the window sills being constructed of concrete, and the walls above of brick. The floors and roofs are of reinforced concrete, as are also the building columns. The roofs are nearly flat, and the drainage leaders are brought down through the interior of the building to avoid freezing in cold weather.

Although the buildings are of practically fireproof construction, an excellent fire-protection system has been installed. In the annex to the boiler house there is located a fire pump of 1,500 gallons per minute capacity, this being a standard Underwriters' duplex, made by the Knowles Steam Pump Company. To insure immediate availability of service, steam is constantly kept up in the Stirling boiler plant adjoining, and an emergency supply of 150,000 gallons of water is continually kept in an underground, concrete-lined reservoir near the pump. The fire equipment includes pipes for sprinklers and numerous coils of hose connected to auxiliary piping, each coil being marked by a distinct signal light.

The heating and ventilating of the buildings is carried out on the direct system, air being drawn from the outside by large fans and discharged into the buildings by means of piping, the foul air finding egress through regular ventilating outlets. The system was installed by Sheldon & Sheldon, of Galt, Ontario.

A particularly creditable feature of the general plan of the works is the arrangement for the convenience of employés. The toilet and bath rooms are located on the mezzanine floors in the different buildings, and are accessible by broad stairways of steel and concrete construction throughout.

With regard to the driving of the plant, wherever feasible induction motors have been used. This refers to group driving, however, as practically all the individually driven tools are equipped with direct-current, variable-speed motors, operated on a three-wire, 220-110-volt system.

Compressed air is used for various purposes, particularly in the foundry and assembling floors for operating pneumatic tools. The compressor, built by the Canadian Rand Drill Company, is located in the main machine shop, and is operated by a fifty-horse-power induction motor. For the annealing ovens and tempering furnaces in different parts of the works, gas and crude oil equipments are necessary. The gas-generating plant is situated in a small building between the machine shop and the foundry. This plant was installed by the American Gas Furnace Company. The gas is made from naptha, a large tank of which is stored under ground. The crude oil equipment, installed by the Rockwell Engineering Company, consists of an underground tank, together with a pump, situated in the gas-generating building, and the necessary piping to convey the oil to the desired points.

The pattern shop is a three-story building and basement. The basement and the first floor constitute a carpenter and cabinet shop, pattern-making proper being conducted on the second and third floors. The pattern-storage building is situated adjacent to the pattern-making shop.

The foundry building is of monitor-roof construction, with three bays. The middle bay constitutes the moulding department, and is served by a twenty-ton crane built by the Northern Engineering Company, equipped with alternating-current motors. The building is also served throughout its entire length by a traveling jib crane of seven and one-half tons' capacity. The cupola room is situated in the northern part of the west bay, the southern part of the same bay serving as the brass foundry. A portion of the east bay is partitioned off to serve as a blacksmith shop.

The general machine shop is equipped with two twenty-ton electric cranes, supplied by the Morgan Engineering Company, and is operated by direct-current motors.

The punch department is at the west end of the small machine shop, and is traversed throughout its length by a five-ton, Northern Engineering Company crane, driven by a direct-current motor. The other departments of the works include the shafting department, located in the small machine shop; the bearing, commutator and brush-holder department, situated directly above the shafting department; the screw-machine department, located on an upper gallery between the warehouse and the machine shop; the test department, the tool room and the general offices.

Allis-Chalmers-Bullock, Limited, Montreal, Quebec.

ALLIS - CHALMERS - BULLOCK, Limited, was originally incorporated in 1903 as the Canadian Bullock Electric Manufacturing Company, Limited, with a capital of $1,000,000, to manufacture chiefly electric apparatus for the Canadian market, in connection with the well-known Cincinnati firm. When the latter company was absorbed next year by the Allis-Chalmers Company, of Milwaukee, Wis., the name was changed to Allis-Chalmers-Bullock, Limited, and the capital increased to $1,200,000. The company also secured for Canada the exclusive rights to manufacture and to sell the varied products of these two companies, with, of course, the benefit of their engineering experience. In the meantime it acquired the present property, and among the valuable franchises held by the former owners, the exclusive right for Canada to manufacture and to sell the hoisting engines, ballast unloaders and other products of the Lidgerwood Manufacturing Company, of New York. The works on the site were at once enlarged and sales offices opened in New Glasgow, Nova Scotia; Montreal, Quebec; Toronto, Ontario; Winnipeg, Manitoba; Nelson, British Columbia, and Vancouver, British Columbia. In November, 1906, the capital was again increased to $2,500,000. There are now over 500 men at work in the shops.

The property of the company, occupying about twenty acres, is situated at Rockfield, three miles west of Montreal, and, being on the bank of the Lachine Canal and skirted by both the Canadian Pacific Railway and the Grand Trunk Railway systems, has excellent shipping facilities. The works, a view of which is given in Fig. 1, include the main machine shop, 400 feet long, 100 feet wide, thirty-five feet high; electric shop and power-house, about the same size; foundry, 200 feet long, 100 feet wide, thirty-five feet high; pattern shop, 180 feet by sixty feet by twenty feet; blacksmith shop, 100 feet by eighty feet by thirty feet; office, and other buildings. As the equipment is thoroughly up-to-date and of a character to be expected in works of this size, it may be of more interest to refer to the company's electrical products.

Although only a few years in business, the company has made surprising progress in many lines. For instance, it has had in successful operation for over a year in the power-house of the Northern Aluminum Company at Shawinigan Falls, Quebec, six 940-kilowatt, direct-current, interpolar generators, the largest machines of

the kind ever built, and the only ones so far in operation in Canada. Their original rating was 2,570 amperes at 365 volts, but they have operated perfectly under 2,570 amperes at 425 volts. The plant of the Laprairie Brick Company, across the river from Montreal, is operated entirely by this company's induction motors, which include one of 500 horse-power, one of 300 horse-power, and other smaller ones, the aggregate being over 1,000 horse-power. The mines of the Asbestos and Asbestic Company, at Danville, Quebec, use one 900-horse-power, two 300-horse-power, one fifty-horse-power and several smaller induction motors. For over a year there has been in satisfactory operation at the high-service pumping station of the Montreal Waterworks a 400-horse-power induction motor, driving at constant speed a fourteen-inch, three-stage centrifugal pump of a capacity of 5,000,000 Imperial gallons in twenty-four hours against 250 feet head. The official test conducted by Professor Herdt, of McGill University, on behalf of the city, showed an overall efficiency of sixty-six per cent on the whole unit. The waterworks plant of the city of Three Rivers includes a two-speed induction motor, capable of 100 horse-power at 900 revolutions per minute, and 150 horse-power at 1,200 revolutions per minute, 2,200 volts, sixty-cycle, three-phase driving a two-stage centrifugal pump, which delivers 1,500,000 Imperial gallons at the slower and 2,000,000 Imperial gallons at the higher speed. The domestic pressure is ninety pounds per square inch, and the fire pressure 150 pounds per square inch.

The new Canadian Pacific Railway Hotel at Winnipeg is lighted by four of the company's seventy-five-kilowatt direct-current generators, and the new Canadian Pacific Railway Hotel at Victoria, British Columbia, by three similar generators. There was recently put into operation a lighting plant for the town of Kenora, including three 625-kilowatt, water-wheel-type alternators, exciters, switchboards and other auxiliary apparatus, all built by the company. At the Canadian Copper Company's works, Copper Cliff, there have been in operation during the past year induction motors built by Allis-Chalmers-Bullock, Limited, aggregating over 3,000 horse-power and including three of 600 horse-power, each three-speed, driving blowing engines; one of 500 horse-power, constant-speed, driving a blowing engine; one of 300 horse-power, driving an air-compressor, and one of 150 horse-power, driving a six-inch, four-stage centrifugal pump.

MR. J. A. MILNE, GENERAL MANAGER, ALLIS-CHALMERS-BULLOCK, LIMITED, MONTREAL, QUEBEC.

The company is now paying particular attention to hydroelectric work, being the only one in Canada which designs and builds both water-wheels and electric apparatus. Among the contracts of this sort recently completed was a plant for the Quebec Railway, Light and Power Company, including a twin horizontal, enclosed turbine, 2,200 horse-power, 222 revolutions per minute, with forty-inch runners, to operate under sixty feet head, direct-connected to a 1,500-kilowatt, 11,000, to 5,500-volt, sixty and two-thirds cycles, two-phase alternator. At the time of writing there were ready for shipment three horizontal turbines each of 5,350 horse-power under fifty feet head, provided with oil regulating governors, for the plant of the Montreal Light, Heat and Power Company on the Soulanges Canal, about forty miles from the city. A novel feature of this development is the use of concrete

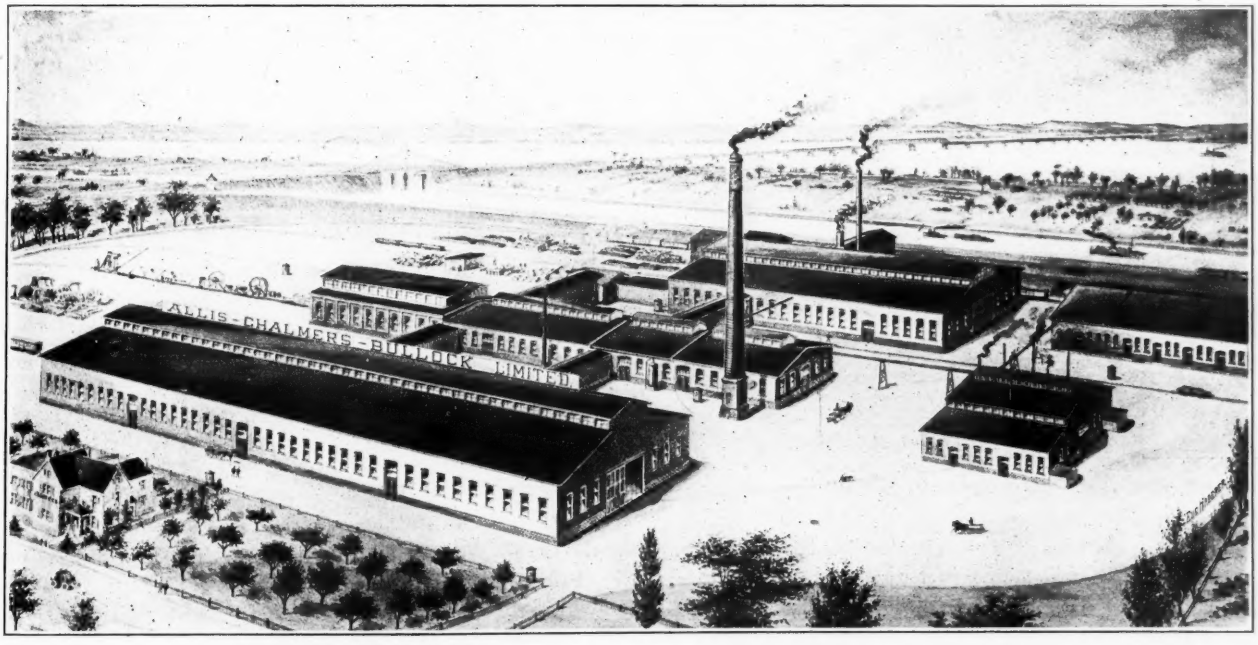


FIG. 1.—GENERAL VIEW OF WORKS, ALLIS-CHALMERS-BULLOCK, LIMITED, MONTREAL, QUEBEC.

draft tubes designed by Allis-Chalmers-Bullock, Limited, and used there for the first time in this country. The company is also the only one in Canada which builds complete electric hoisting engines, and among those under construction was a reversible double-friction drum hoist to be driven by a 150-horse-power induction motor for the Mond Nickel Company, Limited. Fig. 2 is a view of the electrical test department, showing on the left a 300-horse-power, 450 revolutions per minute, 2,200-volt, three-phase, thirty-cycle induction motor, and on the right a 625-kilowatt, 150 revolutions per minute, 2,400-volt, three-phase, sixty-cycle water-wheel type alternator; a 300-horse-power, 500 revolutions per minute, 550-volt, three-phase, sixty-cycle induction motor, arranged for rope drive; a small vertical induction motor for pumping sewage, and other apparatus. Fig. 3 is a view of the winding department, in which are seen lighting transformers, as well as field coils and other details of electric apparatus. The company also designs and builds its own switchboards.

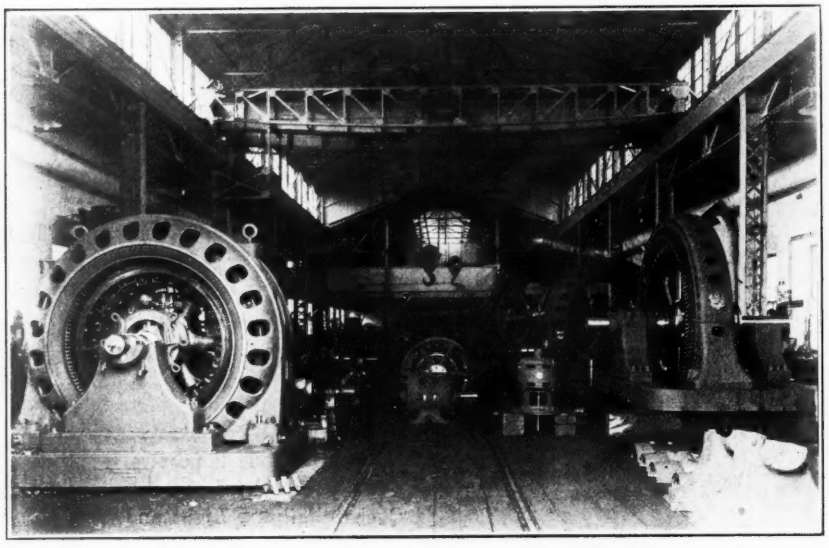


FIG. 2.—VIEW IN ELECTRICAL TEST DEPARTMENT, ALLIS-CHALMERS-BULLOCK, MONTREAL, QUEBEC.

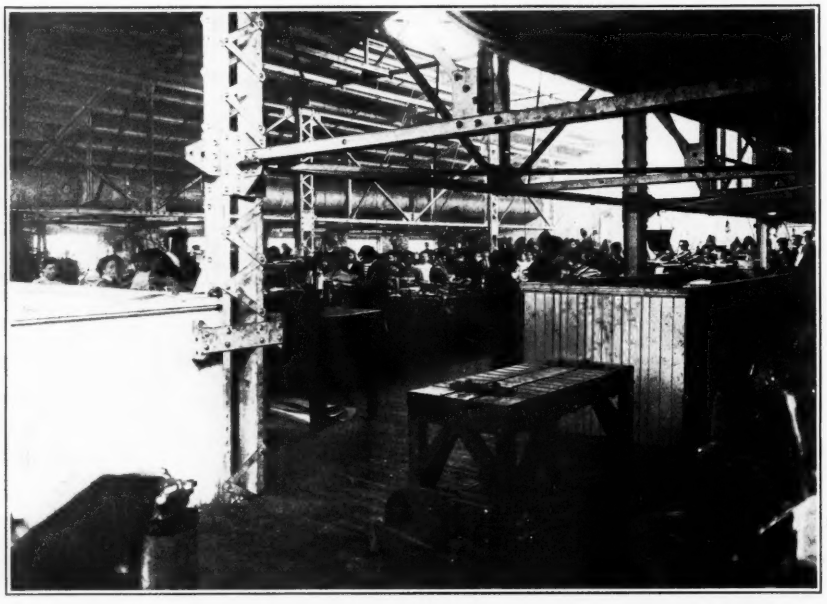


FIG. 3.—VIEW IN WINDING DEPARTMENT, ALLIS-CHALMERS-BULLOCK, LIMITED, MONTREAL, QUEBEC.

The officers and directors of the company are as follows:

President—Edgar McDougall.

Vice-President—Henry J. Fuller.

General Manager—James A. Milne.

Secretary-Treasurer—Arthur F. Cayford.

Directors—Edward D. Adams, chairman finance committee, Allis-Chalmers Company, New York; Charles Allis, chairman, executive committee Allis-Chalmers Company, Milwaukee; George Bullock, president United Gas and Electric Company, New York; Henry J. Fuller, president Canadian Fairbanks Company, Limited, director Canadian Rubber Company, Limited, Montreal; Lloyd Harris, president Brantford Screw Company, Limited, president Canada Glue Company, Limited, Brantford; Phelps Johnson, general manager and director Dominion Bridge Company, Limited, Montreal; Edgar McDougall, president John McDougall Caledonian Iron Works Company, Limited, president Canadian Iron and Foundry Company, Limited, Montreal; Wm. C. McIntyre, president Dominion Woolen Manufacturing Company, Limited, president McIntyre, Son & Co., Limited, Montreal; Wm. McMaster, vice-president and general manager Montreal Rolling Mills Company, Limited, Montreal; James A. Milne, general manager Allis-Chalmers-Bullock, Limited, Montreal; Joseph S. Neave, financier, Cincinnati; W. W. Nichols, vice-president Allis-Chalmers Company, New York; Alex. Pringle, T. Pringle & Son, Limited, director R. E. T. Pringle Company, Limited, director Canadian Rubber Company, Limited, Montreal; James W. Pyke, president J. W. Pyke & Co., president Phœnix Bridge Company, Limited, vice-president Imperial Coal and Coke Company, Limited, Montreal; Walter H. Whiteside, president Allis-Chalmers Company, Milwaukee.

The Packard Electric Company, Limited, St. Catharines, Ontario.

ONE of the representative companies of the Dominion is the Packard Electric Company, Limited, the head offices and works of which are at St. Catharines, with branches at Montreal and Winnipeg. The company's line of products includes incandescent lamps, recording wattmeters, transformers and induction motors. The latter have recently been placed on the market, and are attracting considerable attention, owing to their liberal design, both mechanically and elec-

trically. The Dominion government has recently placed orders with the Packard company for 100 five-horse-power motors for the operation of the lock-gate mechanisms on the Welland Canal. This order was secured after competitive tests had been made by the electrical engineer of the Department of Railways and Canals. Considerable interest is also being manifested in the company's transformers for the reason that some recent orders include units as large as 750 kilowatts, 12,000 volts, twenty-five cycles, for Niagara power circuits.

Until recently the company confined its work principally to smaller sizes, but the large amount of business offered as a result of developments of Niagara power has attracted manufacturers to the district and rendered it necessary for the company to increase its facilities to put its factory in shape to handle a large amount of bigger business which had heretofore been enjoyed by one or two of the older companies. The company is now in a position to compete for this larger business, and has been successful in securing orders for a large amount of work which is now being handled in its factory.

The incandescent-lamp department is the oldest branch of the company's business, having been in operation for nearly fifteen years; in fact, the company was organized to manufacture lamps in Canada and started in Montreal, shortly after moving to St. Catharines. The Packard lamps were used by nearly all of the first electric light plants in Canada. The reputation of the lamps in the old days has been kept up, and as modern methods of manufacture have been introduced they have been adopted, so that the lamp department is up-to-date in every respect, and the demand is such that the facilities are taxed to the limit.

The company's type G recording wattmeter has been on the market for about five years, and during that time nearly 30,000 of all sizes have been sold. The company was the first to incorporate the ball-bearing feature, and such care and attention have been given to every detail that throughout Canada a reputation has been established which makes it one of the most popular meters of its kind on the market, a number of the largest central stations using it exclusively.

The company's business extends throughout Canada from coast to coast, the eastern business being looked after by branch offices in Montreal, and the western business by a branch office in Winnipeg. The central or Ontario section is handled from the main office.

The company is the Canadian representative of the American Instrument Company, the Jandus Electric Company and the Crocker-Wheeler Company. The advent of the latter company into the alternating-current field and the rapid progress which has been made in its development of standard apparatus in both large and small units, have added greatly to the prestige and opportunities of the Packard Electric Company.

The Canadian General Electric Company, Limited, and the Canada Foundry Company, Limited, Toronto and Peterboro, Ontario.

THE annual report of the directors of the Canadian General Electric Company, Limited, and the Canada Foundry Company, Limited, to the shareholders on Wednesday, March 27, showed a total surplus of $1,969,354.39. The business of the company for the year had been most satisfactory, resulting in a profit of $853,675.19. To this should be added in the profit and loss statement the amounts of $220,000 received as premium on the issue of 11,000 shares of common stock, and $90,762.60, being the balance at the credit of profit and loss on the first of January, 1906, making a total of $1,164,437.85. Of this total, $484,690.14 was paid out in dividends; $71,160.12 is credited to bank interest; $320,000 was added to reserve fund, and $219,553.20 was written off for depreciation.

At the present time the company owns unoccupied lands at a cost valuation of $355,000. These lands, which otherwise would be built upon, and impossible to acquire, except at an almost prohibitive price, mainly adjoin the present sites of the manufacturing plants at Peterboro and Davenport.

Last year two new large manufacturing buildings were constructed, one at Peterboro, and the other at Davenport. Both of these buildings are of steel-frame construction, and designed for heavy working strains.

The first invasion of the interests now constituting the Canadian General Electric Company into the industrial field was as Canadian agent for the Thomson-Houston Electrical Company, an American concern, which, less than eighteen years ago, expanded into the Toronto Construction and Electrical Supply Company. This company, after a brief industrial competition, bought out the Canadian works of the Edison General Electric Company at Peterboro, Ontario, and became the nucleus of the present Canadian General Electric Company. The iron and steel department of the present company began to develop in 1900, when the Canadian General Electric Company bought the works of the St. Lawrence Foundry Company. About that time, also, the Diamond Machine and Screw Company was taken over, and shortly afterward the Northey Pump Company.

The works of the Canadian General Electric Company are at Peterboro, seventy-five miles from the city of Toronto. The hydroelectric installation furnishing current for driving the apparatus is located four miles above the works. The plant includes the following departments: Central machine shop, 527 feet by 100 feet, with twenty-five-foot galleries all around; storage and shipping building and punch press department, two stories high, 440 feet by 80 feet, with a forty-foot gallery on one side of the ground floor; lamp and wire department, 272 feet by 50 feet, two stories high; transformer building, 125 feet by 50 feet; compound building, 144 feet by 50 feet; brass foundry, 137 feet by 42 feet; blacksmith shop, 170 feet by 42 feet; carpenter shop and pattern department, 125 feet by 60 feet, two stories high; boiler house, 54 feet by 58 feet; electric substation, 52 feet by 38 feet; carbon building, 150 feet by 75 feet, three stories high; porcelain department, 150 feet by 100 feet, two stories high; storage shed, 204 feet by 26 feet; paint shop, 122 feet by 20 feet. In addition to these there are the new buildings already referred to.

In 1901 a beginning was made on the present shops of the Canada Foundry

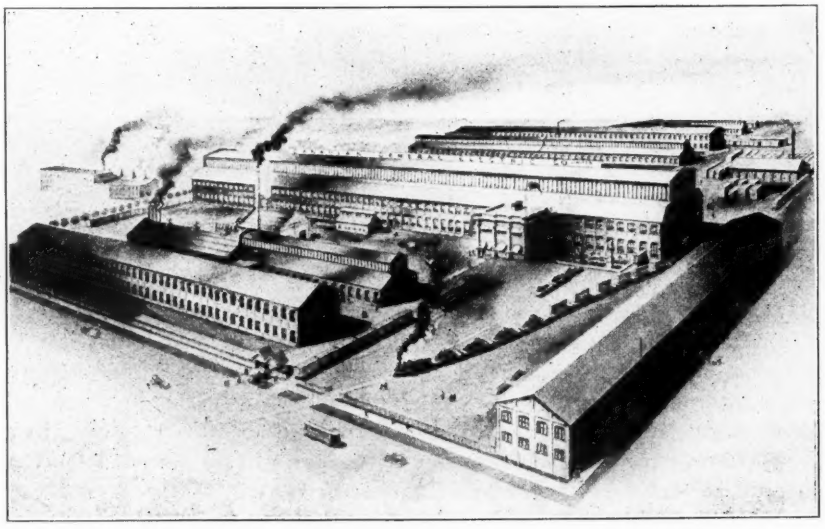
Company at Davenport. The foundry, pattern shop, bridge shop, machine shop and power-house were built on what was practically a barren tract. The next year the bridge shop was more than trebled in size and capacity, and the boiler shop was commenced. Then the company went into making horizontal return-tubular and water-tube boilers and locomotives. Two years later the pipe foundry was added. In 1905 the company went into the manufacture of steam shovels, at first in the yard, later in the machine shop, which at this time is being more than doubled in size. For selling and distributing the output of the works of both the Canadian General Electric Company and the Canada Foundry Company, in addition to the head office at 14 and 16 King street, East, Toronto, branch offices are maintained at Halifax, Montreal, Ottawa, Winnipeg, Roslyn and Vancouver.

The officers of the company are: W. R. Brock, president; H. P. Dwight, first vice-president; Frederic Nicholls, second vice-president and general manager; H. G. Nicholls, assistant general manager and secretary. The directors are the above and Hon. G. A. Cox, Rodolphe Forget, H. S. Holt, Hon. Robert Jaffray, Hon. J. K. Kerr, William Mackenzie, W. D. Matthews, James Ross and E. R. Wood.

Prominent among these directors, and representing most significantly the type of man primarily responsible for Canada's great industrial development, the figure of Frederic Nicholls looms up with greater distinctness than that of almost any other public man in the Dominion. It was in 1874 that Frederic Nicholls, a young Englishman, went to Canada, where he very soon took up the cudgels of the National Policy party and espoused the cause of the Canadian Manufacturers' Association. In 1879 Mr. Nicholls went to Toronto from Ottawa, and became acting secretary of the Canadian Manufacturers' Association, securing the secretaryship in 1882. He soon became a devoted student of the tariff, and made a special study of economic conditions in Canada. In January, 1882, he purchased a paper published in Ottawa, called the *Industrial World*. This paper, under Mr. Nicholl's guidance, was made the organ of the Canadian Manufacturers' Association, and called the *Canadian Manufacturer*. As its editor, Mr. Nicholls became one of the best practical authorities in Canada on the tariff. He led in the onslaught on the commercial union proposed in the United States Congress by Butterworth and Wiman, and during the period between 1886 and 1891 did more to successfully turn the issue toward a national policy than probably any other single individual in Canada. During his early years, as editor of the *Canadian Manufacturer,* Mr. Nicholls became Canadian agent for the Thomson-Houston Electrical Company. Later, in 1886, he established what was known as the "Permanent Exhibition," where electrical apparatus, as it was invented and produced, was shown, and which gained early fame in connection with the first electric trolley car to be run in Canada. This was at the time of the Industrial Exhibition of 1886.

MR. FREDERIC NICHOLLS, VICE-PRESIDENT AND GENERAL MANAGER OF THE CANADIAN GENERAL ELECTRIC COMPANY, LIMITED.

During his early training as a boy in London, and later as the result of his technical education at Stuttgart, Mr. Nicholls was deeply interested in the subject of electricity. Although electricity as a form of commercial power had not been much exploited at that time, and was particularly dormant in Canada, a modest syndicate of ten men, headed by Mr. Nicholls, each contributed $1,000 to a fund for the purpose of investigating the possibilities of Canadian electrical development. One of the immediate results of this enterprise was the organization of the Toronto Incandescent Light Company, which was the first organization to exploit an incandescent system of lighting in Canada. A year later Mr. Nicholls undertook the development of the Toronto Construction and Electrical Supply Company, which was formed to build the apparatus for the Toronto Incandescent Company. This company laid the first underground system of wires in Canada, and shortly after entered into competition with the Edison General Electric Company, which had built a plant in 1880 at Peterboro. The competition resulted in the capitulation of the American company, and that merger was the beginning of the present Canadian General Electric Company. The "Permanent Exhibition" was abandoned by Mr. Nicholls in 1891, and he became associated with William Mackenzie and other interests in railway development. In 1891 the Toronto Street Railway began to electrify its system, the first car being run in Toronto in 1892.



PETERBORO WORKS OF THE CANADIAN GENERAL ELECTRIC COMPANY, LIMITED.

The electric power field, however, appealed to Mr. Nicholls as the really big thing which, together with railway de-

velopment, would bring about an increasing degree of prosperity and expansion in industrial Canada. In order, however, to add to the works for the production of electrical apparatus the foundry facilities which would combine with hydraulics the trinity of power adaptations which would make a commercial syndicate complete, Mr. Nicholls decided to go heavily into the foundry proposition. This determination brought to a head the organization of the Canada Foundry Company, of which Mr. Nicholls is the general manager. In 1900 the St. Lawrence Foundry Company, with works in Toronto, was purchased, and in 1901 the Canada Foundry Company acquired the Diamond Machine and Screw Company and the Toronto Ornamental Iron and Fence Company, as well as the Northey Pump Company, as already described. Later came the organization of the Electrical Development Company of Ontario, Limited, of which Mr. Nicholls is vice-president and general manager, and the transmission system, the Toronto Niagara Power Company, of which Mr. Nicholls is also vice-president and director. Mr. Nicholls is president and director of the Toronto & Hamilton Railway Company, and of the Niagara, St. Catharines & Toronto Railway Company; president of the Albion Power Company, of New York, and of the Electrical Transmission Company, of Niagara Falls, N. Y.; vice-president of the London (Ontario) Electric Company, and director in the Toronto Street Railway; vice-president of the Toronto & York Radial Railway Company and the James Bay Railway, now the North and South line of the Canadian Northern Railway. All told, Mr. Nicholls is an active member of twenty-eight boards of directors. Turning from the electrical field, we find him as one of the leaders in the directorate of the Imperial Rolling Stock Company, Limited, the Canada Car Company, the Canada Foundry Company, the Dominion Iron and Steel Company, the Niagara, St. Catharines & Toronto Navigation Company, and the Canadian Shipbuilding Company.

A few years ago several Canadian capitalists became interested in the power and traction possibilities of South America. Securing franchises in Rio de Janerio, the Rio Janeiro Tramway, Light and Power Company and the Sao Paulo Tramway Company were established, of which companies Mr. Nicholls is a vice-president.

In private life Mr. Nicholls is an enthusiastic sportsman, and his ownership of the yacht Temeraire has made him an international figure in cup contests. He has also devoted a generous portion of his time to hunting and fishing, and is a member of nearly all the big clubs in Toronto. His residence, one of the finest in Toronto, is equipped with a huge conservatory, and his collection of famous pictures is said to be one of the finest in the Dominion. On the academic side he is a director of Bishop Ridley College, and a member of the board of finance of Trinity University.

The Eugene F. Phillips Electrical Works, Limited, Montreal.

THE Eugene F. Phillips Electrical Works, Limited, was incorporated and started business in the summer of 1889, its floor space at that time and for the next year being only 16,000 square feet. In 1899 the floor space was increased to 24,000 square feet, and in 1904 the present factory was built with a floor area of 53,000 square feet. The company is still making splendid progress, and is now adding 23,000 square feet of floor space, and has in every respect a thoroughly up-to-date mill equipped with what is believed to be the best wire-drawing, cabling, braiding and winding machinery. Later this year a hydraulic lead press and other machinery will be installed, so that the company will be in excellent shape to manufacture telephone cables and power cables.

The officers of the company are Frank N. Phillips, president; George H. Olney, 2d, secretary and treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS, LIMITED, MONTREAL, QUEBEC.

Uses of Quicksilver.

The principal use of quicksilver is in the amalgamation of silver and gold ores. The demand for this purpose practically regulates the price of the metal. Considerable quantities are also used in the manufacture of a vermilion pigment, but this industry is suffering a decline, occasioned by the competition of cheaper but inferior red of the vermilion shade, made with aniline dyes. In industrial chemistry quicksilver is used to quite an extent as an electrode in various processes. For example, in the manufacture of caustic soda a solution of common salt is subjected to electrolysis, and the metallic sodium set free combines with the mercury electrode, forming sodium amalgam, which, when treated with water, liberates sodium hydrate. Small quantities of quicksilver are used in medicine, as calomel or corrosive sublimate; as tin amalgam in the manufacture of mirrors; for coating the zinc plates of electric batteries; as gold, copper or zinc amalgams in dentistry; in thermometers, barometers, and various other scientific apparatus; and in electrical machinery where moving or liquid contacts are desired. A new use for the metal is in the mercury vapor electric lamp.—*Mining and Scientific Press.*

Surface-Contact System in London.

The Traction Corporation, Limited, of London, England, has offered to construct an experimental track a mile or so long on the London County Council's system of tramways, using a surface-contact system. This particular system to be tried is known as the G. B., and the reason for using it is that the underground railway runs close to the surface of the road, not leaving sufficient room for a conduit system.

Ohio Electric Light Association.

Thirteenth Annual Convention, Held at Toledo, Ohio, August 20, 21 and 22.

THE recent convention of the Ohio Electric Light Association, which was held at the Boody House, Toledo, on August 20, 21 and 22, in point of attendance went to high-water mark. If numbers and interest are proof of the success of the new departure in policy on the part of the association in the holding of its conventions, its wisdom was amply demonstrated. Toledo, being a lake point and easily accessible, having also ample hotel accommodations, naturally attracted a large local attendance, but aside from this many new faces were noticed by those familiar with the past meetings.

The following were voted in at the first session:

ACTIVE MEMBERS.

Wadsworth Light and Water Company, C. N. Oplinger, superintendent, Wadsworth, Ohio.

The City Heat and Light Company, J. J. Cramer, vice-president and general manager, Fostoria, Ohio.

Theo. S. Garber & Son, proprietors Belleville electric light plant, Belleville, Ohio, E. S. Garber, manager and chief electrician.

The Oak Harbor Electric Company, George C. Mylander, general manager.

New Bremen Electric Light Company, F. H. Plaice, general manager, New Bremen, Ohio.

The Kent Water and Light Company, A. B. Young, Kent, Ohio.

Manufacturers' Light and Power Company, H. O. Fisher, manager, Dunkirk and Forest, Ohio.

Franklin Electric Light Company, L. C. Anderson, secretary and treasurer, Franklin, Ohio.

The Delphos Electric Light and Power Company, H. L. Canfield, secretary and treasurer, Delphos, Ohio.

Wilmington Water and Light Company, J. C. Martin, vice-president and manager, Wilmington, Ohio.

The Loveland Citizens' Electric Company, H. C. Hubbell, secretary, Loveland, Ohio.

The Electric Light Company, J. W. Row, manager, Ottawa, Ohio.

The Lima & Toledo Traction Company, and the Indiana, Columbus & Eastern Traction Company, Francis Alfred Healy, secretary and treasurer.

The Pomeroy & Middleport Electric Company, I. L. Oppenheimer, superintendent. Pomeroy, Ohio.

The McConnellsville-Malta Electric Company, A. Durbin, secretary, McConnellsville, Ohio.

The Tiffin Edison Electric Illuminating Company, C. B. Rodgers, general manager, Tiffin, Ohio.

Cambridge Power, Light and Traction Company, J. A. Middleswart, secretary, Cambridge, Ohio.

East Liverpool Traction and Light Company, J. H. Rothery, general manager, East Liverpool, Ohio.

The Hicksville Electric Light and Power Company, Hicksville, Ohio.

The Maumee Electric Company, Maumee, Ohio.

The West Liberty electric light plant, West Liberty, Ohio.

ASSOCIATE MEMBERS.

Westinghouse Electric and Manufacturing Company, J. W. Schrantz, Cincinnati, Ohio.

The Western Gas Fixture Company, E. N. Riddle, secretary and treasurer, Toledo, Ohio.

The Toledo Chandelier Manufacturing Company, H. G. Boyers, manager, Toledo, Ohio.

Curtis Advertising Company, Charles A. Parker, secretary, Detroit, Mich.

New York & Ohio Company, H. E. Gorton, assistant manager.

The Electric Supply and Construction Company, Mark Siminton, treasurer.

The Post-Glover Electrical Company, J. E. Swisher, general manager.

The Morman Gas Fixture Manufacturing Company, C. S. Brookins, vice-president, Cleveland, Ohio.

Babcock & Wilcox (Stirling Department), Barberton, Ohio, R. D. Crawford, chief electrician.

Western Electric Company, F. A. Henderson, Chicago, Ill.

John A. Stewart Electric Company, Paul Stewart, treasurer and manager, Cincinnati, Ohio.

W. G. Woolfolk, Sanderson & Porter, New York.

The Cleveland Gas and Electric Fixture Company, Cleveland, Ohio.

The Brilliant Electric Company, Cleveland, Ohio.

The Toledo Electric Company, Toledo, Ohio.

The Excello Arc Lamp Company, New York city, N. Y.

TUESDAY MORNING SESSION.

The first number on the programme was the address by President Engel, which gave special prominence to the thought that the present need of central stations is to foster the commercial side of their enterprise by cultivating the best relations with the public and energetically pushing a campaign of education along all lines. President Engel took it for granted that one of the best means to secure business is to furnish the very highest class of service, and assuming that the central station is doing this, the next thing is to thoroughly acquaint the public with the merits of the service.

Papers on "Factory Lighting" were read by Messrs. A. P. Biggs, of the Edison Illuminating Company, Detroit, Mich., and J. Kermode, of the Cleveland Illuminating Company, Cleveland, Ohio.

Mr. Biggs considers that the incandescent lamp, in large sizes, is still inefficient as compared with electric and gas arcs, Cooper Hewitt and Nernst lamps. The Nernst lamp is desirable in small-space lighting and for machine shops and foundries with low ceilings. The usual factory lighting can be considered by central station men as unprofitable business. He concludes that an electric light company can not afford to take on all factory lighting offered to it; that it is obliged to take a certain amount which is inherently unprofitable; that it should minimize this amount by advising the customer how to reduce his demand by utilizing light to the best advantage and by advocating the transfer to daylight hours of any power load that can be dispensed with during the evening hours. He should also pass over to the gas company such factory space lighting as can be profitably furnished by gas arcs, retaining for electricity the long-hour localized lighting.

Experience has taught that no general rule can be laid down to govern the many different situations that present themselves. Each factory must be studied separately to determine the amount of light, style of illuminant and the method of its installation, to give the best results. Large units can not be successfully operated in roundhouses or car shops, because the principal parts of locomotives needing special attention are so located that, to be of value, the source of light must be reflected from each side of the engine. Five 100-watt Gem lamps, spaced fifteen feet apart, at an elevation of seven feet, will light in a very satisfactory manner one side of two engines. Oil torches, commonly used in cabs, boiler and floor pits, can be replaced with portable incandescent lamps. In foundries, forges, steel mills, structural iron works and boiler shops, where the walls are dark and the work does not require concentrated light, enclosed arc lamps, giving a white light combined with shadows, are undesirable.

In discussing the papers, F. W. Willcox, of the General Electric Company, commended the points made which need further emphasizing, namely, the necessity for proper engineering and proper education of the factory managers and workmen in the efficient use of lamps, as often more depends on the efficient use than upon the intrinsic efficiency of the type of lamp itself. The practice of using unshaded lamps is wasteful in the extreme in its failure to direct and confine the light where needed.

Professor F. C. Caldwell, of the Ohio State University, who is always a welcome participant in these meetings, thought that the matter of keeping lamps clean is one that should have special attention in the case of factory lighting; the actual cost to a manufacturing company of keeping lamps in use free from grease and dirt, as mentioned in the paper, would be very small and would very greatly add to the effectiveness of the light and to

the satisfaction of those working in the shop. The conditions in this respect are deplorable in ordinary shops, and there is no place else where a like condition prevails.

TUESDAY AFTERNOON SESSION.

The first business of the afternoon session was a paper by H. P. Grabill, of the Ashland Gas and Electric Company, on "Luminous Arcs From the Standpoint of the Central Station Operation."

The Ashland Gas and Electric Light Company installed, in December, 1905, ninety type 2 magnetite lamps, the rate for energy on a moonlight midnight schedule being $68 per lamp per year. During the present summer these lamps are being replaced with the type 3 lamp, which corrects the only defect the company has found in the magnetite lamp. In place of a swinging upper electrode, a stationary one is used. The latter gives better service, and is reversible, thus practically doubling its life. A heavier closed globe is used instead of one with an open bottom. The company's experience proves the magnetite lamp to have many decided advantages over the open arc lamps.

In reply to inquiry, the author stated that his station is furnishing street lighting on a moonlight schedule, and that on an all-night schedule the lamps would have to be trimmed probably twice as often.

The paper on "Electric Heating Devices," prepared by M. E. Turner, was read by Mr. Kermode, the author being unable to be present because of illness.

Mr. Turner finds that electric heating is bidding for favor in all departments of household work. He has considered it important to refer briefly to criticisms which have been received concerning these devices. The first general criticism is that most electric heating devices are too slow in heating. What is needed is higher temperature during the first few minutes, and, if necessary, more current should be used for a shorter space of time. The second general criticism is that the methods used for attaching appliances to the electric circuit must be improved. It is desirable that the attachment be a removable, flexible cord, with a simple, durable plug. Electric cooking tables and cooking outfits are being supplied in various forms by a number of manufacturers, and these are meeting with considerable success. Electric ovens with heaters top and bottom are superior bakers, but are decidedly wasteful of heat.

Mr. Rothery stated that several years ago, when a new Carmelite hospital was erected at Niagara Falls, it was decided to heat, light and cook by electricity, and an arrangement was made whereby they were to be furnished power at $12 per horse-power for 24-hour service per year, a figure below that at which any ordinary central station throughout the country could probably supply it. The experiment was tried by the hospital for one year, and then abandoned, the decision having been arrived at that it was cheaper to heat their building by hot water, light by electricity and cook with coal.

Professor Caldwell thought that the cost of cooking and heating devices for the kitchen especially must be reduced, as there is no place where a greater desire is felt to retrench than in kitchen appliances. He also suggested that still more attention be paid to developing the factor that is already such a valuable consideration with electrical devices, that is, the power to apply the heat just where needed. In present methods of cooking, heat is wasted unnecessarily to a very large extent. The question of better lagging, or heat insulation, is one of the important things that ought to be improved. This is the more important with all apparatus that is intended for short periods of use, and at intervals, as would usually be the case in cooking.

Mr. Kermode reported that the only trouble they had had with flat-irons was with the large tailoring iron. One factory had ninety-eight irons of this kind in one room, 115 volts. The building was remodeled and the room made larger, and due to the length and size of the copper and the desire to reduce same, it was suggested that they use 220-volt irons. The 115-volt had not given any trouble to mention, but on going over to the 220-volt to save cost of inside wiring and also to get their flat-irons on the same meters with their power in order to get the benefit of the best possible arrangement they could get on their power contract, they encountered trouble with the irons.

Mr. Martin, in a town of 700 customers, including 600 resident customers, has out some 100 irons. Twenty-five or thirty of these were put out a year ago and proved quite satisfactory, and during the year the additional seventy-five were put out. He has had eight or ten of them returned for repairs, and a part of these due to bad usage. He estimates that for a family of six the iron is worth $1 a month to the station; it is one of the best current-consumers the station has.

Mr. Plaice stated that they started in his town in 1905 with twelve irons placed on a flat-rate charge of seventy-five cents for a family of five, and five cents for each additional member. He lost ten irons the first year out of twelve, and concluded it was bad business. The second year, however, he placed everything on meter basis, and last year put out about fifty, losing but three out of that number. He has eighty this year, and so far has not lost one. Eighty per cent of these irons are rented; the balance maintained by the central station. He also said that the manufacturer should give a better cord for the iron; it breaks off close to the iron, causing some annoyance in being repeatedly called to make the same character of repair. The iron should be connected up at both ends. In connecting up irons he does not allow the customer to put them on to the general lighting outfit. He puts in a special drop. The simpler and easier you can make this connection, the better.

L. W. Cady, of the W. J. Barr Electric Manufacturing Company, Cleveland, referring to the defects complained of by some of the speakers, said that his company has overcome the defective cord proposition by a cord protector that prevents the cord from breaking out of the iron, and breaks the circuit both close to the iron and at the attachment plug which attaches the connector cord to the service wires.

WEDNESDAY MORNING SESSION.

The first thing on the programme of Wednesday was the subject of "Cooperative Commercialism in the Electrical Field," on which J. Robert Crouse was to give a paper. Being compelled to leave the city, Mr. Crouse requested Mr. Tait, manager of the Dayton Lighting Company, to give an abstract of the paper presented by Mr. Crouse at the Washington meeting of the National Electric Light Association in June last.

Professor F. C. Caldwell read his paper on "The Best Form of Power for Stations of 500-Kilowatt Capacity or Less."

Professor Caldwell points out that there are now available the following types of apparatus: Direct-current, two-wire, 220-volt; three-wire, 110-volt, and alternating-current, single-phase or polyphase. The choice between these will depend, first, on the character of the load to be supplied; second, upon the size of the plant, and third, upon the conditions under which it will be operated. A few years ago the two-wire, 220-volt, direct-current system seemed likely to take an important position for the smaller central station supply. Two factors, however, have recently been introduced, which are both unfavorable to its growth. The first of these is the development of metallic-filament incandescent lamps, which appear to make the highest voltage improbable. The other factor is the placing on the market of successful three-wire generators at a cost not greatly in excess of the standard types. The problem may therefore be narrowed down to a question of three-wire, direct-current, *versus* alternating-current, single-phase, or polyphase. As between direct current and alternating current, the question of distribution of load is the most important factor. Wherever more than one town is to be supplied from the same plant, or where the character of the farming population is such as to make the sale of power and light among it a matter of importance, the decision must be in favor of alternating current. On the other hand, where the conditions seem to set comparatively narrow limits to the area which the plant will supply, greater simplicity, higher economy in distribution, and superior regulation will call for the direct-current system.

In the discussion following, Mr. Bechstein asked Professor Caldwell what he would consider an economical unit as between the turbine and the reciprocating engine.

Professor Caldwell replied that the question was much too open to be answered categorically. As he understood it the steam economy in the case of small turbines is not materially different from the same size reciprocating engine, at

least when the engines are new. It is claimed by the turbine people that the turbine will maintain its efficiency better than the reciprocating engine; that is, that it is not so likely to get out of order and thereby require more steam; but where the engines are new the speaker thought the saving in fuel is not such as to be much of a factor in determining the use of the turbine over the reciprocating engine.

Mr. Adams agreed with Professor Caldwell in regard to the use of gas fuel; there is a great saving in fuel effected by gas engines. The speaker's company is now operating 500 horse-power and installing 250 horse-power more, and has experienced no difficulty whatever.

President Engel asked if Mr. Adams was using gas engines exclusively?

Mr. Adams replied in the affirmative. He has two Westinghouse engines of 280 horse-power each, and is installing a Wells-Strothers of 250 horse-power, made at Warren, Pa.

Mr. Bechstein inquired how Mr. Adams was able to take care of his load in case of a break in the gas mains; whether he had a producer plant, and if so, how long it would take to get it in operation?

Mr. Adams replied they were fortunate in that respect, since his company was the Logan Natural Gas and Fuel Company, which bought out a natural gas company. Should a break occur they have ample holder capacity which would take care of their needs until the break could be repaired. They also have a holder with a water tank, and utilize the water over and over again so that they pay no water rent, only a little in the summer when the weather is extremely hot. In the winter time, have no water bill at all.

Mr. Semans, Winchester, Ind., stated that they had operated for the past seven years a plant, both water and light, with gas engines, and had found same very satisfactory; they have two Westinghouse 125-horse-power gas engines driving the dynamos; two forty-horse-power Nash engines driving the water power. Have found them satisfactory in every way. The cost of operating is estimated as about half what it would be with coal, that is, the fuel expense. Operate with one man night, and one man day-time. Have a boy to stay with the night man and sleep at the plant; they pay thirty cents per 1,000 cubic feet for natural gas.

Aside from the regular programme, at the suggestion of Mr. Gwynn, of Delaware, the subject of ways of selling day current was discussed by Messrs. Gwynn, Bechstein, Russell, Townsend, Rothery, Conkling, Martin, Lockwood, Adams, Selig, Plaice, Rust and others, it developed that owing to local conditions, such as difference in cost of fuel, and other causes, there was a wide divergence of rates charged for day power load.

WEDNESDAY AFTERNOON SESSION.

At 2 P. M., the joint paper by C. C. Collins and A. N. Cope, of Columbus, was taken up, the former being superintendent of the Columbus Railway and Light Company, and the latter of the Columbus Public Service Company. The paper was in the nature of a report, showing results in tabulated form as obtained by various central stations in Ohio and elsewhere.

Mr. Dutter quoted a case in his city where a merchant ran ten lamps in each show window putting them on averaging two nights a week; these have been replaced by four tantalum lamps in each window which are being used until 10 o'clock every night, paying the central station more money and giving the patron more satisfaction. Both the Gem and tantalum are pleasing people. The result of the 400 installed by this station has been to broaden the peak. Use 110-volt, direct-current, three-wire.

In discussing the paper Mr. Willcox said that the new units had the advantage that there is no antiquation or writing-off depreciation considered; the lamp renews itself; there is no depreciation of the renewal cost. The Gem lamp costs so little more than the ordinary carbon lamp that the majority of stations can afford to furnish them on the same liberal basis of renewals as the ordinary lamp, and the speaker believed they were doing so to a large extent. The tantalum lamp is a different proposition as it is a more expensive lamp. The matter of renewals must be carefully considered, therefore, in presenting its claims to those who have been using the older form of lamps and getting free renewals of same. Central stations that are furnishing free renewals of ordinary lamps on a rate of two cents per kilowatt-hour can furnish the tantalum for three cents or two and one-half cents to cover the additional cost of renewals. A similar course can be pursued with regard to the introduction of the tungsten lamps, the renewal cost of which would be still higher than the tantalum. Another plan would be to adopt the practice of the gas companies and charge a fixed maintenance charge; if that works satisfactorily with the gas companies it might work well with incandescent lamps. For the tantalum a charge of five cents per month would amply cover it. At present there is no complete data as to the life service of the tantalum lamp. The problem of how best to introduce the new lamps and how to meet conditions as established with the lower-efficiency lamps formerly in use is a very interesting one to the central station manager. In some way or other the central station should maintain the control of the lamp, because the ordinary user does not know how and will not take proper care of the maintenance of his lamps. The service should be kept up to standard by intelligent care on the part of the station.

The actual number of tantalum lamps sold in this country to-day has been probably 250,000 or 300,000, and the difficulty of getting them on the market in accordance with the demand last year was such that it retarded sales to some extent. More could have been sold if supplied faster.

Professor Caldwell asked if it is true that in the case of the tungsten lamp there is practically no depreciation in candle-power during the life of the lamp; also, in what sizes will the tungsten probably be put on the market?

Mr. Willcox replied that in operation the multiple and series lamps are different; in one case a change in resistance is being overcome by constantly increasing the voltage from the regulating apparatus, and therefore maintaining the candle-power, theoretically, practically through life; tests made of some series tungsten lamps have shown that the candle-power is practically maintained to the end of the life. The multiple tungsten lamp has a very good life; just how much can not yet be stated. The life seems to be in the neighborhood of 1,000 hours, with a good candle-power life of ninety per cent. It is a little too early to say what these lamps will do; there have not been enough of them used to prepare full data. Tungsten lamps are produced in similar sizes to the present Gem units. Perhaps the lamps of 100 watts give about eighty candle-power, mean horizontal; lamps of fifty watts give about forty candle-power; forty watts, about thirty-two candle-power. The tungsten has not been as yet listed, but the cost will probably be higher than that of the tantalum lamp. By using the lamp in the larger size the cost will not be so great as in the smaller sizes. It costs pretty nearly as much to make a small candle-power lamp as a large one.

Otto Foell said that, viewing the situation from an engineering point, there seems to be no immediate need for a higher efficiency lamp than the multiple glower type of Nernst lamp. In the endeavor to secure new business and to meet competition successfully, there has been a tendency on the part of the central station managers all over the country to reduce rates for current, and it is a question where does the higher efficiency lamp help the central station manager to check the reduction in rates. Undoubtedly what a customer wants is light; and he wants plenty of it, and not current. On the other hand he wants a light which he can maintain with advantage to himself, for should the central station maintain the lamps, same must be done on a basis to insure a profit on the business.

Taking for example the forty-candle-power, fifty-watt tungsten lamp which is listed at $1.50 and which may be obtained in large quantities at, say $1.10. This lamp, according to the manufacturer's statement, has an average life of 1,000 hours, which is equivalent to a current consumption of fifty kilowatt-hours; that is, the maintenance cost per kilowatt-hour for such a lamp amounts to 2.2 cents, which, in the case of free renewals must be added to the price of current to insure the same net revenue on the connected load. Two of these lamps are equivalent to the new 110-watt higher-efficiency Nernst lamp, which can be maintained, according to the inquiries of the association's committee, at one-half cent per kilowatt-hour.

Bringing both types of lamps on the same candle-power basis, and for 1,000 hours' use, gives a renewal cost for the tungsten lamp of 4.4 cents against .55 cent for the Nernst lamp, while the current consumption is 100 kilowatts against 110 kilowatts; that is a slight increase in current consumption against a considerable saving in maintenance.

The 110-watt higher-efficiency Nernst lamp has been developed for the purpose of not only getting a screwbase lamp somewhat larger than the 110-watt lamp, but also to bring this type of lamp to the same efficiency as is obtained in the larger multiple-glower type of Nernst lamps.

Replying to the last speaker, Mr. Willcox, while admitting that the Nernst lamp was a good one, contended that it had the disadvantages of high initial investment cost, difficult care and maintenance cost which the cheap incandescent lamp avoids. It was unfair to condemn a new lamp that is passing through a development stage and predict its failure to meet certain conditions before it has had an opportunity to show what it can do commercially.

C. H. Davis said the association's committee on high-efficiency units makes reference to the high investment incurred as the result of the policy of lending Nernst lamps, but it inadvertently omits some necessary qualification. A comparison of the cost of one system which is furnished to the consumer in toto, as in the case of the Nernst lamp complete, should not be made with the cost of the renewable element only of another system. If to the cost of the Gem lamp the cost of the necessary shade, shade-holder and socket be added, the investment per kilowatt connected will not be materially less than with the Nernst lamps.

If the central stations recognized no advantages in the free lamp policy with reference to the Nernst lamps, they can just as consistently and just as readily require the consumer to purchase that portion of the Nernst equipment which is permanent; that is, the lamp body and the globe, as to require the consumer to purchase the reflector and holder for the Gem lamp. The two systems should thus be placed on a parity before comparisons in cost are made. Again the central station desires, of course, to keep their investment in load installation as low as possible in order to secure and hold the business, and it would seem more consistent to compare the investment with the amount of illumination required. On this basis the one-glower and two-glower Nernst lamps cost about the same as the Gem lamps with their necessary equipment, while the larger sizes of Nernst lamps cost materially less, that is, per candle-power of light produced.

J. D. Kenyon addressed the convention on the general subject of "Helps to a Solicitor," outlining the elements of scientific salesmanship.

Mr. Kenyon shows how it is becoming more apparent every day that there is a science underlying salesmanship, and that it is necessary that men engaged in selling things should master this science. The time is also at hand when managers can not wait for men to be trained. There is a ready market for men who have been properly trained, and these will get the chance where others will have to wait.

A. S. Miller, of the Dayton Lighting Company, read his paper on "Helps to a Solicitor, and What Fifty Cents' Worth of Electricity Will Do."

This paper calls attention to the many devices which can be installed upon a circuit at not only a small first cost, but which will be very cheap in maintenance. He points out that with a one-quarter-horse-power motor, fifty cents' worth of electricity will do eight washings, the machine also wringing the clothes. A six-pound flat-iron will consume about five cents' worth of current per hour. A twelve-inch fan can be operated for three and one-half hours per day for thirty days for fifty cents. This same rate also applies to the sewing-machine motor, the porch light, the heating pad and any number of cooking utensils and small power appliances.

Mr. Bechstein referred to the opportunity for putting out motors to run refrigerating plants. The time is coming when private ice plants run by electric motors will supplant the ice man at $6 a ton. One installation in his city was giving good satisfaction, and has been in operation since last December, on a meter basis.

At the suggestion of Mr. Gwynn the rest of the afternoon was given over to a discussion on wiring, and the advisability of the central station undertaking this, or *vice versa.*

President Engel asked whether the members had found within the past year or two that wiring done on the outside by contractors is as satisfactory as when the central station does it itself.

Mr. Rothery said that in East Liverpool they had never interfered with the wiring contractors, believing it better not to interfere with other industries. The company keeps in close touch with owners of new buildings, ascertains their wants and advises them as to the probable cost of wiring and of furnishing light by electricity; it also keeps close to the contractors and believes that they are generally reasonable and satisfactory in work and charges. It also keeps in touch with the insurance inspectors and depends largely on them to watch the work of the wiring contractors.

Mr. Russell reported that at Massillon, a town of 15,000, there are no wiring contractors, and his company does all the work in that line. Their plan when offering to wire a small house, say five rooms, is to offer wiring provided the house owner will pay a minimum bill of $1.50 a month for two years; that is figuring that it will cost $9 to wire the house; the ordinary minimum being $1, this allows fifty cents monthly to pay for the wiring. If he does not want to pay $1.50 for two years, he can have the option of $1.25 for four years. In this way the company has taken on 120 new customers of this kind in the last two months and a half.

Mr. Martin bought over a municipal plant in his town in February, 1903, and was, until October 1, 1904, rebuilding the plant. At that time the plant had 159 customers on the books and fifteen or twenty who were not on the books, and hence not paying. He began with no power customers, running from 5 A. M. until 11.30 at night. He installed 375 kilowatts in apparatus and began working for customers. He has secured a 400-horse-power motor-load driving the largest auger-bit manufactory in the United States, and a number of other factories. There is only one local contractor and the company never bids against him.

Mr. Kermode reported that in Cleveland, after investigation, the company had arrived at an average unit price per outlet on wiring and a separate price for all switches, receptacles and drop lights installed. The Cleveland office is allowing fifteen per cent of the wiring cost to apply on light bills; it takes about three months to take up that allowance. The company is now gradually taking off solicitors and paying contractors for each house added; the contractors have now some ten men in the field soliciting on a commission basis.

THURSDAY MORNING SESSION.

On Thursday morning papers were presented on the subject of "Best Ways to Meet Gas and Gasolene Competition," by the following: F. H. Golding, Dayton Lighting Company; Samuel Rust, Greenville Electric Light and Power Company; W. E. Russell, Massillon Light, Heat and Power Company; Arthur Pomeroy, Cleveland Illuminating Company; E. T. Selig, Mount Vernon Electric Light Company, and W. C. Anderson, Canton Light, Heat and Power Company.

Mr. Golding considers that proper advertising and keeping solicitors well informed in regard to the advantages of the use of electricity will prove an effective form of competition to meet gas and gasolene service. The fact that the majority of central stations now furnish free lamp renewals is a good argument, because it is hardly probable that the gas companies are in a position to furnish free mantles.

Mr. Rust believes that the customer simply compares the cost of gas or gasolene with that of electricity, and decides in favor of the former, because it appears to be cheaper. The central station solicitor must meet the customer at just that time when he is dissatisfied with his gas or gasolene service, and, presenting the advantages of electricity, close the contract upon this basis.

Mr. Russell believes in securing newspaper clipping service, and bringing to the attention of the users of gas and gasolene the dangers which are attendant upon such service. In addition to this, the rates should be adjusted so that they will be attractive to the non-user. Lamps should be renewed free. Space should be contracted for in the local paper, and the advertising should be changed quite often. Wiring of both new and old houses should be done at an economical rate.

Mr. Pomeroy believes that care should

be taken, in preparing an estimate for an installation, to point out to the prospective customer all the elements of cost which enter into the utilization of either gas or gasolene, and which are not usually charged up as such, so that a fair basis of comparison may be established. The factors of depreciation and repair should also be pointed out, and many important items brought to the consumer's attention which are usually overlooked.

Mr. Anderson has had natural gas to compete with in Canton. Notwithstanding this, electric lighting has shown a considerable increase each succeeding year. He suggests that rates should be made giving the long-hour burners a price in proportion to the cost of the long-hour service. Decorative lighting should be developed to the fullest possible extent.

Mr. Selig believes that the first thing necessary is to be able to give good, reliable service. A sliding scale of charges should also be made, and lamps should be renewed free.

In the discussion following Mr. Beil commented favorably on the suggestion by Mr. Golding that small current consuming devices, negligible themselves as to their effect in increased revenue, were often the means of introducing electricity to notice and securing patronage that otherwise would not have been secured. He instances renting fans for the summer months, particularly to those who had sickness in the family, as one of the ways of inducing patronage that would extend to lighting, etc.

Mr. Selig asked whether the form of wiring contract used at Cleveland was not equivalent to a lien on the property?

Mr. Kermode replied that his company did not guarantee any account, neither was there anything in the contract that was in the nature of a lien or mortgage. Are not now paying the contractors a bonus, but making property owners a rebate of fifteen per cent to apply against lighting bills. The central station assumes some responsibility if doing the wiring itself.

Mr. Gwynn related the experience had at Delaware in regard to the company doing the wiring. This had been profitable and satisfactory; it was a valuable aid to the trouble department, which had to be maintained anyhow, and also largely influenced the getting of new business. When wiring or any repairs are done the customer is asked to sign a ticket showing the character of repair and time of men performing same.

In response to a query by the chair as to how many stations do their own wiring, twelve responded in the negative and twenty-one stations reported that they did wiring.

Mr. Custer thought that if the company keeps its hands off the wiring its advice will be more often sought and followed when a customer desires to make a change in his installation, as the company will then be considered a disinterested party.

Mr. Martin reported that at first his company let somebody else do the wiring, but unsatisfactory work done by wiring contractors had shown the necessity for the company to do this work. It accordingly bought out the local contractors with the exception of one. By reason of the fact that it does the wiring it hears of troubles promptly and can as promptly correct and remedy them. The collector carries a trouble book, and is instructed to report all complaints to the office after entering same in his book. All repairs are charged for with the exception of fusing.

Mr. Kermode said that they had had a great deal of trouble in Cleveland with parties stealing current. The state law makes it a felony and the offender can be brought before a justice of the peace and bound over to the grand jury. About ten such cases in Cleveland, after being bound over, nothing more was heard of them; it is almost impossible to convict under the state laws at the present time. A city ordinance has been drawn up making theft of current a misdemeanor; any policeman that an inspector might find on his beat has the power under this ordinance to arrest the man without swearing out a warrant before a justice of the peace. At present there are some fifteen or twenty people stealing current in Cleveland; it is the policy of the company to give them all the rope they want until the necessary evidence is obtained to convict.

Secretary-Treasurer Gaskill submitted his report, which was duly audited and found correct. The report shows that the association is in good financial standing.

The secretary recommended that the dues of associate members be increased to $10 a year, which recommendation, on motion of Mr. Hanley, was adopted.

The nominating committee, Messrs. Hanley, Rust and Hubbell, submitted their report, which was unanimously adopted, the officers elected being as named therein, as follows:

President—F. M. Tait, Dayton.

Vice-President—E. H. Beil, Youngstown.

Secretary-Treasurer — D. L. Gaskill, Greenville.

Executive committee—W. P. Engel, Defiance; M. E. Turner, Cleveland; D. W. Low, Alliance; W. F. Hubbell, Wauseon; J. C. Rothery, East Liverpool.

Advisory committee—Samuel Scovil, Cleveland; C. R. McKay, Toledo; D. L. Gaskill, Greenville.

Publicity committee—W. J. Hanley, Cleveland; Samuel Rust, Greenville; J. T. Kermode, Cleveland.

Finance committee—W. E. Miller, Mt. Gilead; T. D. Buckwell, Toledo; G. N. Clapp, Middletown.

Mr. Martin, chairman of the committee on resolutions, submitted a report, which was unanimously adopted.

President Engel returned his thanks to both the active and associate members for valued assistance rendered during the year in contributing to the success of the convention and in securing new membership. Out of some 180 central stations in the state there are now but fifty that are not members of the Ohio Electric Light Association, and it is hoped to bring every one of them in during the coming year. The amusement features of the convention were worthy of notice, and consisted for the evenings of a theatre party at the Casino, supper at Toledo Beach, a boat ride on the Greyhound with the usual accompaniments of music and dancing, and the various ladies' contests scattered throughout the afternoons and evenings. The dinner at Toledo Beach was an especially enjoyable affair and reflected great credit on the management of Douglas Buckwell, of the local company.

Among those in attendance were the following:

W. G. Nagel, W. G. Nagel Electric Co., Toledo, O.; H. E. Adams, W. G. Nagel Electric Co., Toledo, O.; Nathaniel Emerson, Wagner Electric Mfg. Co., Cincinnati, O.; G. R. Clover, Nernst Lamp Co., Chicago, Ill.; L. C. Norton, F. Bissell Co., Toledo, O.; F. W. Willcox, General Electric Co., Harrison, N. J.; Fred Bissell, The F. Bissell Co., Toledo, O.; Marvin W. Hansen, Hansen Electric Co., Toledo, O.; A. J. Carney, The W. G. Nagel Electric Co., Toledo, O.; F. M. Knierim, The F. Bissell Co., Toledo, O.; A. F. Knierim, The F. Bissell Co., Toledo, O.; A. E. Foster, The F. Bissell Co., Toledo, O.; A. A. Serva, Fort Wayne Electric Works, Ft. Wayne, Ind.; Walter S. Bissell, The F. Bissell Co., Toledo, O.; C. S. Kuntz, The F. D. Lawrence Electric Co., Cincinnati, O.; Geo. Williams, Allis-Chalmers Co., Cleveland, O.; Elliot Reynolds, Doubleday-Hill Electric Co., Pittsburg, Pa.; H. C. Houck, General Electric Co., Cincinnati, O.; F. B. Galloway, Brilliant Electric Co., Cleveland, O.; C. H. Davis, Nernst Lamp Co., Chicago, Ill.; W. V. Orr, Adams-Bagnall Co., Cleveland, O.; R. T. Hamilton, Banner Electric Co., Youngstown, O.; Paul Stewart, John A. Stewart Electric Co., Cincinnati, O.; F. A. Henderson, Western Electric Co., Chicago, Ill.; L. W. Cady, W. J. Barr Electric Co., Cleveland, O.; W. J. Barr, W. J. Barr Electric Co., Cleveland, O.; Mrs. W. J. Barr, W. J. Barr Electric Co., Cleveland, O.; Miss Quail, W. J. Barr Electric Co., Cleveland, O.; Miss Libscomb, Allis-Chalmers Co., Washington, D. C.; Mrs. Williams, Allis-Chalmers Co., Cleveland, O.; Mrs. Paul Stewart, Stewart Electric Co., Cincinnati, O.; C. R. Bellings, Westinghouse Electric & Mfg. Co., Cleveland, O.; George S. Vail, Westinghouse Electric & Mfg. Co., Cleveland, O.; George H. Porter, Electric Appliance Co.; J. Robert Crouse, Cooperative Electrical Development Association; H. H. Hughes, Westinghouse Co., Pittsburg, Pa.; G. W. Armstrong, Excello Arc Lamp Co.; Thomas S. Richards, Wagner Electric Mfg. Co., St. Louis, Mo.; R. D. Crawford, Babcock & Wilcox Co., Barberton, O.; F. R. DeGray, The Erner Electric Co.; G. E. Miller, Westinghouse Electric & Mfg. Co.; J. W. Brooks, John A. Roebling's Sons Co.; W. W. Affleck, John A. Roebling's Sons Co.; V. I. Gray, The F. Bissell Co., Toledo, O.; Edward B. Terry, The F. Bissell Co., Toledo, O.; Mrs. A. G. H. Jensson, F. Bissell Co., Toledo, O.; W. B. Wilkinson, Western Electric & Mfg. Co., Pittsburg, Pa.; A. E. Alley, General Electric Co., Cincinnati, O.; N. C. Cotabish, National Carbon Co.; A. G. Summerall, National Carbon Co.; Adrian Tobias, Duncan Electric Mfg. Co.; F. C. Colwell, Allis-Chalmers Co., Cincinnati, O.; Mrs. F. C. Colwell, Allis-Chalmers Co., Cincinnati, O.; F. W. Sinran, The Adams-Bagnall Electric Co., Cleveland, O.; J. P. Tompson, W. G. Nagel Electric Co., Toledo, O.; J. A. Campbell, National Metal Moulding Co., Pittsburg, Pa.; A. S. Hertz, General Electric Co., Cleveland, O.; A. B. Pyke, National Carbon Co., Cleveland, O.; H. G. Steele, Pittsburg Transformer Co.; W. H. Woods, Western Electric Co.; D. C. Guest, Western Electric Co.; H. D. Haring, Western Electric Co., Indianapolis; H. P. Larnum, Erner-Hop-

kins Co., Columbus, O., Circleville, O.; F. Haeshaw, Brilliant Electric Co., Cleveland, O.; Albert Ackerman, General Electric Co.; C. W. Chappelle, General Electric Co.; P. A. Summers, F. Bissell Co., Toledo, O.; J. W. Schrantz, Westinghouse Electric & Mfg. Co., Cincinnati, O.; H. J. Mauger, General Electric Co., Schenectady, N. Y.; E. L. Van Winkle, Post-Glover Electric Co., Cincinnati, O.; R. W. Palmer, General Electric Co., Columbus, O.; C. H. Johnson, Curtis Advertising Co., Detroit, Mich.; L. C. Brown, General Electric Co., Lynn, Mass.; R. R. Braggins, H. W. Johns-Manville Co., Cleveland, O.; Otto Foell, chief engineer Nernst Lamp Co., Pittsburg, Pa.; J. D. Kenyon, vice-president Sheldon School, Chicago, Ill.; W. J. Hanley, General Electric Co., Cleveland, O.; F. M. Bliss, Buckeye Electric Co., Cleveland, O.; H. J. Douds, J. G. White & Co., New York; R. H. Winiers Electric Co., Toledo, O.; V. C. Maxwell, F. Bissell Co., Toledo, O.; J. C. McQuiston, Westinghouse Co., Pittsburg, Pa.; Bryon C. Drewior, F. Bissell Co., Toledo, O.; R. D. Nye, Westinghouse Electric & Mfg. Co., Cleveland, O.; F. H. Krauss, Banner Electric Co., Youngstown, O.; Ford S. Smith, Smith Chandelier Co., Detroit, Mich.; C. H. Wilcox, Arbuckle-Ryan Co., Toledo, O.

MR. F. M. TAIT, PRESIDENT, OHIO ELECTRIC LIGHT ASSOCIATION.

WITH THE EXHIBITORS.

Parlor A was the headquarters of the Fort Wayne Electric Works, and was illuminated by the smiling countenance of Tom Ryan, district manager, and George B. Edgar, of Cincinnati, flanked by A. A. Serva, assistant sales manager, of Fort Wayne. Exhibiting fan motors, new watt-meter calibrator just being put out on the market, line of literature, etc. Mr. Ryan was highly pleased with the practical nature of the papers read at convention.

The General Electric Company occupied parlor B, with a host of good entertainers, H. C. Houck, manager, Cincinnati; F. W. Willcox, and G. C. Osborn, of Harrison, N. J.; A. E. Alley, Cincinnati; A. S. Hertz, Cleveland; Percy Worth, Indianapolis; and last, but not least, that old reliable in Ohio State Association work, W. J. Hanley, now of Cleveland. Exhibiting new type high-efficiency units, tantalum in fifty and eighty watts; new street service lighting tungsten; twenty-five-watt, twenty-candle-power tungsten for use four in series in commercial lighting, and 100-watt, eighty-candle-power multiple tungsten lamp. The five-light fixture hung on the stairway, equipped with tungsten lamps, created a good deal of favorable comment.

The Nernst Lamp Company had parlor C, distributing handsome and up-to-date printed matter, including photos of typical Nernst installations. There was also a six-glower Nernst in canopy housing. The convention hall was beautifully illuminated with Nernst lamps—one hung in front of the Westinghouse exhibit. Represented by Otto Foell, Charles H. Davis and G. R. Clover, of Chicago office.

The Westinghouse Electric and Manufacturing Company was in parlor C; represented by G. E. Miller, manager; Mr. Wagenhorst, C. P. Billings, of Cleveland; G. S. Vail, Cleveland; Hughes, of Pittsburg, and J. C. McQuiston.

The Western Electric Company, Chicago, in parlor H, was represented by H. D. Haring, Indianapolis; D. G. Guest, Chicago; F. A. Henderson, Cleveland; and showed multiple and series arcs; full line of high-tension porcelain and electrose insulators; new indestructible coil arcs. An interesting feature of the display was the discovery by visitors that they could light a cigar by short circuiting the new indestructible coil arc and applying cigar to the resistance coils.

MR. E. H. BEIL, VICE-PRESIDENT, OHIO ELECTRIC LIGHT ASSOCIATION.

The John A. Stewart Electrical Company, Cincinnati, Paul Stewart, treasurer and manager, kept open house in parlor 64, and gave away souvenirs in the shape of combined paper knife and letter opener. Their mission was to buy second-hand machinery. A large streamer on the stairway also kept them before the public.

Parlor K was reserved for the Allis-Chalmers Company, Milwaukee, showing electrical apparatus and steam turbines; five-horse-power induction motor; seven-and-one-half-horse-power, direct-current motor; samples of turbine blading. Represented by George A. Williams, Cleveland, and that good mixer and genial friend, F. C. Colwell, of Cincinnati.

The Oneida galvanized chain for suspending arc lamps, made by the Oneida Community, Limited, was exhibited in Parlor N.

The Wagner Electrical Manufacturing Company, St. Louis, Mo., was represented by N. Emerson, of Cincinnati, who is a regular attendant at these meetings, and T. S. Richards, of St. Louis; showing single-phase, variable-speed motors, with auto-transformer control. Another new device in shape of portable lamp-testing voltmeter and wattmeter; eight instruments in one.

Cleveland Electrical Supply Company, represented by L. Griesser, manager; W. C. Marker, secretary; Warner Jones, salesman; H. H. Cudmore, distributed watch fob souvenirs and celluloid statistical cards.

The Western Gas Fixture Company hung a chandelier in the convention hall with five two-glower Nernst lamps attached. It was represented by Edward N. Riddle.

The Excello Arc Lamp Company, New York, represented by G. W. Armstrong, hung two ten-hour Excello flaming-arc lamps at the Superior street entrance of the Boody, and two seventeen-hour flaming arcs on the St. Clair side entrance. The seventeen-hour is used principally in factory lighting on account of the long-hour burning. This concern has put in some large installations this year, notably with the National Tube Works, Mester Machine Company, United Engineering and Foundry Company, General Casting Company and Pennsylvania Steel Company. Have just closed a deal with the Murphy Power Company, Detroit, for illuminating the building exteriorly.

MR. D. L GASKILL, SECRETARY-TREASURER OHIO ELECTRIC LIGHT ASSOCIATION.

The Chicago Electric Appliance Company, represented by F. J. Alderson, Chicago, and George H. Porter, Columbus, exhibited in the lobby Sangamo direct-current and alternating-current integrating wattmeters. Souvenirs in the form of pocket mirrors.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Westinghouse Multiple Arc Lamp.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has placed on the market a lamp of new design containing a number of features which add materially to close regulation, durability and convenience in manipulation. The well-balanced, symmetrical appearance may be noted in Fig. 1. The lamp is of the rocker-arm type, distinguishing it from lamps operated by a direct lift. This construction, in which the weight of one part of the mechanism is balanced by another, and the necessary pull of the magnet is greatly decreased, allows the use of a smaller-sized magnet, bringing about less heating in the coils and less vibration, with a consequent elimination of noise. The lamp-hanger loop is large and heavy, and supports the lamp on a large porcelain bushing, which is held to the fork of the support by a composition cotter pin.

The terminal binding-posts are cast of composition metal and set in petticoated porcelain insulators, a square recess in the insulators engaging a square projection on the terminals, which are thus prevented from turning.

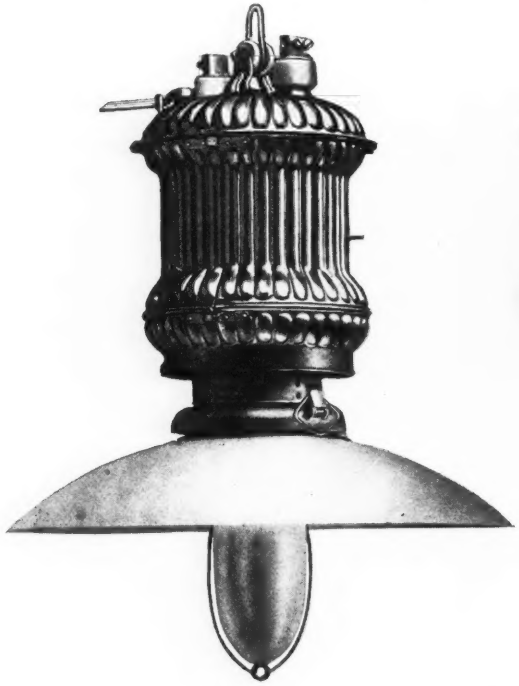
The case and cap are pressed from high-grade copper with corrugations which add to their rigidity. The cap is formed from a single piece, and has the shoulders of the terminal supports pressed into it. The exterior is regularly finished in mottled copper, but other finishes can be supplied if desired.

The door, shown in Fig. 2, forms one-third of the case and affcrds ready access to all parts of the mechanism.

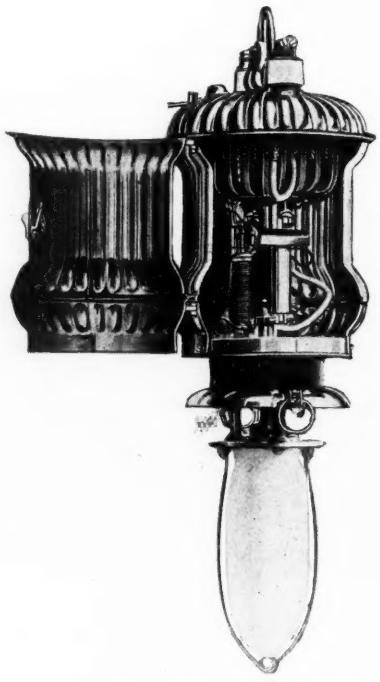
The lamp switch, shown herewith, has a composition metal handle. An inverted cup, which forms a part of the handle, covers the opening in the cap and prevents leakage at this point. The switch blade is formed of a heavy plate of vulcabeston with a copper button molded in its end and so placed that a movement of the handle brings it in contact between the head of a brass bolt to which one binding post is secured and a heavy piece of spring brass attached to the central tube, throwing the lamp into circuit.

The choke-coil is attached to the heavy metal punching that forms the base of the hanger, by copper rivets which pass through the cap and the supporting arm. The choke-coil is thus carried directly by the hanger instead of the housing or the central tube, which are thus relieved of the strain of its weight.

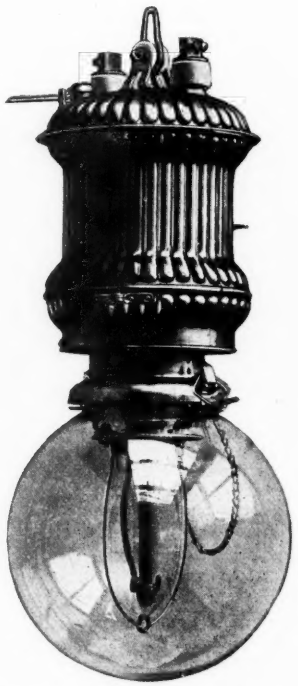
The choke-coil is fireproof in its construction. It is made up of a number of separate coils on a laminated iron core and provides sufficient re-active resistance for use on 120-volt circuits.



SINGLE GLOBE LAMP, WITH OPAL SHADE.



LAMP WITH DOOR OPENED FOR INSPECTION OF MECHANISM.



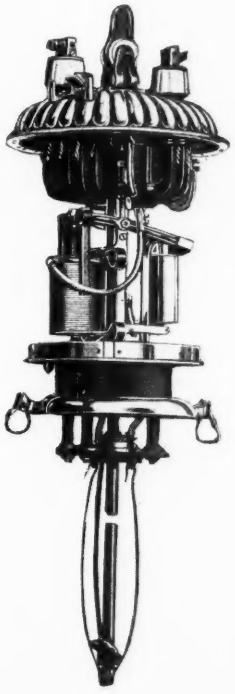
MULTIPLE ALTERNATING ARC LAMP WITH CLEAR GLOBE.

The voltage adjustment is made through a flexible cord connected to one lamp terminal, having upon its lower end a screw connector connected to one of the loops between adjacent windings of the choke-coil, choice being made of the loop which will give the lamp the voltage desired. Each loop gives a variation of from three and one-half to five volts, depending upon the line voltage and the current for which the lamp is adjusted.

The magnet consists of a single coil with an E-shaped armature. The winding is made fireproof and is suspended from the central tube by flat phosphor bronze springs.

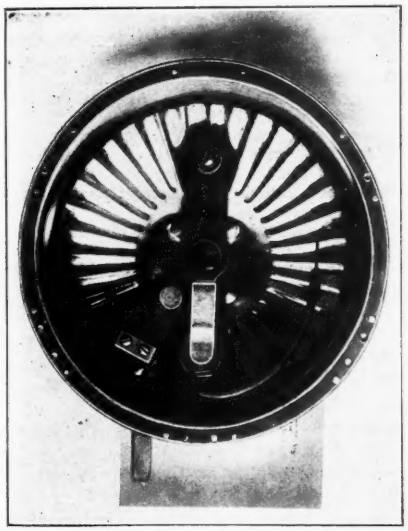
The armature of the magnet is built

up of laminated iron, and is designed to give as uniform a pull as possible throughout its entire range of travel. It is suspended from the rocker-arm by a spring which eliminates vibration and noise.



LAMP MECHANISM.

The rocker-arm is of cast metal supported upon carefully designed phosphor bronze pivots, the bearing being supported



INTERIOR OF LAMP CAP, SHOWING SWITCH.

from the central tube. The dash pot, clutch rod and balancing weight are attached to the opposite end of the rocker arm from the armature, and as the armature draws downward it raises the clutch rod, clutch and upper carbon and thus strikes the arc.

The dash pot is of the vacuum type, and has a hollow graphite plunger so designed that it can not be made to stick under the most severe conditions of temperature or humidity.

The clutch consists of a porcelain ring enclosed in a copper band which is attached to the clutch rod by a cotter pin.

The upper carbon sheath is electrically connected to the central tube by means of a flexible cord, a screw in the sheath passing through a slot in the tube and the movable end of the cord being attached to the screw. The cord is thus wholly outside the tube.

The gas check is made of metal with lava centre. It also serves to carry the single side rod and the inner globe support.

The lower carbon clamp is provided with a steel wire bail which prevents the lower carbon from slipping down through the holder in case the clamping screw becomes loosened.

The inner globe is held in place by a spring stirrup which is suspended from the gas check. It passes beneath the globe, a depression in the lower end of the globe being the only point at which it touches, and exerts a steady, even upward pressure which keeps the edge of the globe at all points in close contact with the gas check.

The outer globe is attached to the lamp by a globe holder which meets with universal approval. The globe is encircled by a wire loop which has projections on each side which engage loops depending from the levers on the globe holder. When the levers are raised, the globe is drawn firmly against the holder and held there by a toggle action. Throwing the levers outward loosens the globe so that it may be removed. The wire collars or hoops are interchangeable and adjustable, thus allowing for variation in manufacture, and are attached to the lamp by a chain and snap hook.

The "Lehall-Radiant."

The "Lehall-Radiant" is a new electric adjustable bed and portable-stand lamp combined. The accompanying illustrations give an idea of the uses and appearance of the lamp. It is constructed of solid brass throughout, polished and lacquered; is strong, durable and fully guaranteed. A ball-and-socket joint between the clamp and the lamp socket permits the latter to be adjusted to any angle desired, directing the light precisely where it is wanted and protecting the eyes from the direct rays. The reflector is specially designed to concentrate the light, and has

THE "LEHALL-RADIANT" AS A PORTABLE.

an inner surface which reflects the rays evenly.

It is needless, of course, to dwell upon the advantages of the electric lamp as a bed light. Its features of convenience and cleanliness and its freedom from giving

THE "LEHALL-RADIANT" AS AN ADJUSTABLE BED LAMP.

off noxious gases or vitiating the atmosphere are obvious.

The lamp is made by Louis E. Hall, 740 Monadnock Building, Chicago, Ill.

Current Electrical News

DOMESTIC AND EXPORT.

WIRELESS IN CHINA—The viceroy at Canton, China, has sanctioned the installation of wireless telegraphy in the various parts of the city. A wireless telegraph school is to be opened.

NEW LIGHTING SYSTEM TO BE INAUGURATED IN QUERETARO—A new and complete system of arc lighting will be inaugurated in Queretaro, Mexico, on the occasion of the festivities which are being organized for September 16. The old system left much to be desired and a complete installation of new and powerful arc lamps is being made.

CALIFORNIA GAS AND ELECTRIC CORPORATION TO INCREASE CAPITAL—A special meeting of the California Gas and Electric Corporation, a subsidiary company of the Pacific Gas and Electric Company, will be held next October to authorize an increase in the capital stock from $15,000,000 to $30,000,000, preparatory to the making of a new bond issue to provide for refunding and extensions.

WIRELESS TELEGRAPH TO JAPAN—Japan and Russia are said to be planning the establishment of wireless connection with Siberia. Japan is connecting the shores of Vladivostok and Tsuruga, on the western shore of the island of Hondo. It is proposed to lay the plans before the various chambers of commerce interested and also before the International Telegraph Conference next April, for endorsement. The new line is expected to cut in two the present telegraphic rates between Europe and Japan.

PLANS FOR MILWAUKEE MUNICIPAL ELECTRIC LIGHT PLANT BLOCKED—City Controller Paul Bechtner of Milwaukee, Wis., has refused to countersign bids for a municipal lighting plant. The controversy will be aired in the courts. It has been estimated by Hunt & Company, of Chicago, that the plant will cost nearly $1,500,000. The city has voted $500,000 for a plant, but of this only $237,000 remains. Controller Bechtner says that until the city has funds with which to build a plant he will not allow the work to proceed.

KANSAS CITY RAILWAY COMPANY ACQUIRES OTHER LINES—The Joplin & Pittsburg Railway Company, of Kansas City, Mo., incorporated recently with $5,000,000 capital, of which $2,800,000 is outstanding, has taken over the properties of the Pittsburg Railway and Light Company, of Pittsburg, Kan., and the Joplin & Pittsburg Street Railroad Company, the latter having under construction a line to the city of Joplin. It is the purpose of the company to connect the lines acquired at Pittsburg with those at Joplin, to effect which a line twenty-six miles in length is being built. Several branches and extensions are also under construction. When these new lines are completed the company will have eighty-two miles of trackage. A mortgage has been made to the Germantown Trust Company, of Philadelphia, as trustee, to secure an issue of $5,000,000 five per cent first mortgage bonds dated June 10, 1907, and due July 1, 1927, but subject to call on and after July 1, 1910, at 105 and interest. Of the bonds $2,800,000 will be issued to cover the roads acquired and the cost of additional construction. The balance will be reserved for future uses.

TELEPHONE AND TELEGRAPH.

RANDOLPH, VT.—Work has been completed on a new telephone line from Randolph to Chelsea.

RED BLUFF, CAL.—Residents of the Bend and Jilly districts have constructed a telephone line from those places to Red Bluff.

NORTH BROOKFIELD, MASS.—A new switchboard will be installed at once and other changes made for the betterment of the service.

NORTH ATTLEBORO, MASS.—The Providence Telephone Company is arranging for a number of new trunk lines between this city and Providence.

CALUMET, MICH.—The Michigan State Telephone Company has completed the installation of a telephone system in the Tamarack mine. About thirty-eight instruments are in use.

SERGENT, KY.—A new telephone line is being constructed by the Letcher County Home Telephone Company from Whitesburg, *via* Mayking, Sergent and Craftsville, to Boone's Ford, sixteen miles.

FULTON, N. Y.—The Oswego County Independent Telephone Company has a large force now in the field installing telephones at the rate of thirty or forty a day. The system is to be up-to-date in every respect. The company now has about five hundred contracts for telephones in Fulton and this number is rapidly growing.

AURORA, MO.—Nearly 400 contracts, extending over a period of three years, have been executed in this city for a new telephone exchange. The new company is known as the Aurora Independent Telephone Company, and will have free exchange with Mt. Vernon, Marionville and Verona, and probably other neighboring towns. Direct communication with Joplin, Kansas City and St. Louis will be made over the Kinloch line. The material for the exchange has been purchased and work will be hastened.

SPRINGFIELD, MASS.—The New England Telephone and Telegraph Company is putting in a new $20,000 switchboard to care for the increase of the local business, and otherwise is making a particular effort to improve the service. The local service has been growing so rapidly that the facilities have become inadequate, and the new switchboard, which will be on the first floor, will be able to take care of the overflow. The average rate of growth in the company's business is about 150 telephones a month, and there are now about 8,700 telephones connected with the Springfield switchboard. More than 100 operators and supervisors are employed. No further plans have yet been made for the erection of the company's proposed new building at the corner of Stearns park and Worthington street. According to Superintendent F. G. Daboll, the present quarters, with the added switchboard, will take care of the growth for the next two years. None of the equipment of the present building can be used in the new building.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

Canadian Electrical Exhibition. Montreal, Quebec, September 2-14.

Canadian Electrical Association. Annual convention, Montreal, Quebec, September 11-13.

Old Time Telegraphers' and Historical Association and Society of the United States Military Telegraph Corps. Annual meeting. Niagara Falls, N. Y., September 16-18.

Vermont Electrical Association. St. Albans, Vt., September 18-19.

Colorado Light, Power and Railway Association. Annual convention, Denver, Col., September 18-20.

New York State Independent Telephone Association. Annual convention, Syracuse, N. Y., September 25.

Railway Signal Association. Annual meeting, Milwaukee, Wis., October 8-10.

American Electrochemical Society. Fall meeting, New York city, October 10-12.

American Street and Interurban Railway Association. Atlantic City, N. J., October 14-18.

LEGAL NOTE.

NEGLIGENCE OF RAILWAY EMPLOYEE—A passenger, induced by the negligent act of the conductor to leave a street car at a point remote from her destination, is held in Georgia Railway and Electric Company *v.* McAllister (Ga.), to be under no legal duty to apply for shelter at houses in the vicinity of the place where she alights, rather than attempt to reach her destination on foot over a highway which is in a reasonably safe condition for travel by pedestrians.

OBITUARY NOTE.

MR. GEORGE W. BUZZELL, president and general manager of the Citizens' Telephone and Telegraph Company, St. Johnsbury, Vt., was killed by an electric shock on August 12. Mr. Buzzell went to St. Johnsbury seven years ago and organized the company of which he was president. He was born at Thetford, N. H., on February 29, 1851, and is survived by one daughter. Mr. Elisha B. Seeley, of Boston, Mass., has been elected to succeed Mr. Buzzell.

PERSONAL MENTION.

MR. P. BACON, of Portland, Ore., has been made manager of the Pacific States Telephone and Telegraph Company's office at Pendleton, Ore., succeeding George Coombs.

MR. A. J. MILLISON, who has been chief operator at the Point Loma, Cal., government wireless telegraph station has been transferred to a point in Alaska, where the government is establishing another station. W. R. McDonald is now the chief operator at Point Loma.

MR. T. A. KERR has been elected manager of the Eastern Illinois Independent Telephone Company, of Kankakee, Ill., succeeding A. J. Vernier, manager of the company since its organization. It is Mr. Vernier's intention to devote most of his time to a new plant that is being installed at Pontiac.

MR. P. P. CRAFTS, of Clinton, Iowa, has assumed the position of general manager of the Joplin & Pittsburg Railway Company, Kansas City, Mo., succeeding Fred H. Fitch. Mr. Crafts has been general manager of the Iowa & Illinois Railway Company, a high-speed road operating between Clinton and Davenport, Iowa.

MR. DAVID FOX, who since March, 1902, has been general manager of the Rutland Railway, Light and Power Company, of Rutland, Vt., which controls the Chittenden Power Company, the Rutland Street Railway Company, the People's Gas Company, and the Rutland City Electric Company, has resigned and will leave Rutland early in September. Mr. Fox has other business interests which will later take him to Mexico. Mr. Fox will be succeeded by George S. Haley, who for several years has been superintendent of the Rutland City Electric Company.

MR. F. B. MALTBY, who has been connected with the Panama Canal work as principal assistant engineer to J. F. Stevens, has resigned to go with Dodge & Day, engineers and constructors, Philadelphia, Pa., in the capacity of chief engineer. Mr. Maltby is a graduate of the University of Illinois, class of 1882, and in 1907 received an honorary degree from the same institution. He has had a long experience in railroad construction work, municipal engineering and irrigation work, and been connected at various times with the Wisconsin Central, Missouri Pacific, Great Western and Illinois Central railroads. He had charge, for the United States Government, of all the dredging operations in the lower Mississippi river and designed and built the lock and movable dam on the Osage river in Missouri for the Government. He has been connected with the Panama Canal for the last two and one-half years, having had charge of the construction of railroads, docks and wharves, shops and dredging. He constructed a cold-storage plant, laundry and bakery in Panama. Mr. Maltby has designed over $1,250,000 worth of dredging plant for the canal work and the preliminary plans and construction work for the great Gatun lock and dam were done under his direction.

ELECTRICAL SECURITIES.

Immediately following the utterances of President Roosevelt on the occasion of the laying of the corner-stone of the Pilgrims' Monument at Provincetown, Mass., on Tuesday, August 20, the stock market showed a brief rally, but this was temporary in the extreme, much uncertainty and unsettlement following. Transactions were numerous, covering the entire range of securities, although at no time was trading very active. This is shown in the fact that the total sales for the week amounted to 2,794,900, as against 5,101,100 shares last week, and 4,380,000 the week previous. However, nearly all of the leading industrials show advances of from one-half to five points, though it is true that quite a number show declines, even from last week. While much has been said of late concerning the near possibility of retrenchment and hard times, and while it is certain that a good many of the daily papers are unanimous in crediting to the Federal government the responsibility for every break which takes place in the stock market, conservative business men are not at all unanimous in predicting hard times. Leading men in the steel and iron trade in Pittsburg, in the boot and shoe trade of the New England states, in the great dry-goods centres of the world, representatives of the leading granaries of the West, and leaders in mining developments of the West and Northwest appear to agree that there will be a healthy retrenchment, but we will not even nearly approach a condition which can be construed as reflecting hard times. In many instances throughout the country, large industries, in consequence of their excellent credit, have expanded their works to such an extent that they have over-reached themselves. In some cases, indeed, there has been such a struggle to secure money enough to carry on these extensive enlargements, that with a dwindling money market, pressure has been brought to bear which could not be withstood, and either a receivership or outright failure has resulted. The inherent prosperity and stability of business is shown, however, by the financial statement of considerably greater losses in business than for many years, though the total of business failures is much smaller. This shows in one direction that the strains have been heavy upon otherwise solvent concerns, and in the other direction, indicates that business is such that heavier losses can be sustained without ending entirely disastrously for the victim of the financial circumstances.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 24.

New York:	*Closing.*
Allis-Chalmers common	5⅞
Allis-Chalmers preferred	20
Brooklyn Rapid Transit	40¾
Consolidated Gas	102½
General Electric	121½
Interborough-Metropolitan common	8¼
Interborough-Metropolitan preferred	21¾
Kings County Electric	112
Mackay Companies (Postal Telegraph and Cables) common	62
Mackay Companies (Postal Telegraph and Cables) preferred	60¼
Manhattan Elevated	110
Metropolitan Street Railway	41
New York & New Jersey Telephone	100
Western Union	75
Westinghouse Manufacturing Company	137

The dividend of 1¾ per cent for the current quarter on the Manhattan Elevated Railroad Company's stock, guaranteed by the Interborough Rapid Transit Company, will be payable October 1.

The Allis-Chalmers Company will soon issue a call for the tenth and last payment of 10 per cent on the bond issue of $13,000,000 created last year. Of that amount approximately $10,500,000 was subscribed for, the syndicate taking about $9,500,000. This will give the company about $1,000,000 additional cash.

In view of the sharp decline in Metropolitan Street Railway stock, and the report of the proposal to pass or cut the guaranteed 7 per cent dividends, steps have already been taken by Philadelphia stockholders toward united action to protect the interests of the unassented stock of the Metropolitan Street Railway Company. George S. Graham has been employed as counsel, and communication has already been entered into with large holders of Metropolitan Street Railway stock, located in New York.

The total income of the Westinghouse Electric and Manufacturing Company for the month of July aggregated $534,486, which was at the rate of $6,413,832 a year. The total income for the four months ended July 31 was $2,477,582, or at the rate of $7,432,746 a year. The net surplus for the four months ended July 31 aggregated $1,377,708, or at the rate of $4,133,124 a year. The surplus for July was at the rate of $3,657,912 a year.

Boston:	*Closing.*
American Telephone and Telegraph	105½
Edison Electric Illuminating	—
Massachusetts Electric	—
New England Telephone	108
Western Telephone and Telegraph preferred	—

Philadelphia:	*Closing.*
Electric Company of America	8⅞
Electric Storage Battery common	44
Electric Storage Battery preferred	44
Philadelphia Electric	7¾
Philadelphia Rapid Transit	16
United Gas Improvement	85

Chicago:	*Closing.*
Chicago Telephone	107
Chicago Edison Light	137
Metropolitan Elevated preferred	64¼
National Carbon common	72
National Carbon preferred	112

Subscriptions to the stock of the Chicago Telephone Company now amount to $4,000,000. The American Telephone and Telegraph Company took $2,000,000, and an individual $1,000,000.

NEW INCORPORATIONS.

RACINE, WIS.—Electrical Construction Company. Capital increased from $6,000 to $18,000.

HATTIESBURG, MISS.—Union Electric Company. $5,000. Incorporators: A. N. Sexton, C. J. Sutherland, W. H. Mace, C. S. Greaves and R. H. Pender.

ST. PAUL, MINN.—Electric Board Power and Lighting Company, Minneapolis. $100,000. Incorporators: W. W. Leonard, C. W. Stribley and Frederick Fayrann.

MADISON, WIS.—The Curtiss & Withee Telephone Company, of Hoard, Clark county. $900. Incorporators: Theodore Thompson, William Peterson and J. S. Jacobson.

AUGUSTA, ME.—Winthrop & Readfield Telephone Company. To do a telephone business in Kennebec and Androscoggin counties. $10,000. President and treasurer, E. M. Leavitt, of Winthrop.

ELIZABETH, ILL.—Elizabeth Light, Heat and Power Company, Elizabeth. To operate a heat, light and power plant. $25,000. Incorporators: H. E. Murray, F. M. Martin, R. R. Longenecker.

RICHMOND, VA.—Weyers Cave Light and Power Company, Weyers Cave. $5,000. J. S. Sellers, president; N. I. Kagey, secretary and treasurer; J. N. Crawford, I. B. Kagey, W. B. Wampler, all of Weyers Cave.

LITTLE ROCK, ARK.—Choctaw Telephone Company, of Perry. $5,000, of which $2,500 has been subscribed. Incorporators: M. N. Spencer, president; John S. Harris, vice-president; S. H. Spencer, secretary and treasurer; G. B. Colvin.

COLUMBUS, OHIO—The People's Municipal Light and Power Company, of Columbus. To construct electric light and power plants and to operate them. $100,000. Incorporators: E. W. Tyler, F. C. Mathey, Samuel C. Davies, George Caunter and T. W. McCue.

SPRINGFIELD, ILL.—East St. Louis & Eastern Railway Company, with headquarters at East St. Louis. $2,500. To be constructed from a point near Belleville in a westerly direction to East St. Louis. Incorporators: L. C. Haynes, T. W. Gregory, G. C. Pierce, F. H. Thomas and F. H. Kruger.

SPRINGFIELD, ILL.—Chicago Interurban Electric Railway Company, with principal offices in Chicago. $100,000. To be constructed from Chicago south through Harvey, South Holland, Town of Calumet, Thornton, Chicago Heights and Steger, in Cook county, to Crete, in Will county; thence west to Joliet; thence across the line from Blue Island through Calumet, Riverdale and Dalton; thence northeast through Thornton and West Hammond and other cities and towns to be determined upon. Incorporators and first board of directors: J. M. McGill, John W. Humphrey, Claude E. Fitch, L. E. Eaton, J. M. Miller, H. D. Moreland and Fred F. Myers.

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The Electric Shoe Cleaning Machine Company, of Boston, has been incorporated with a capital of $50,000. The president is T. F. Lamson, of Boston; the treasurer, Edward H. Greene.

JERSEY CITY, N. J.—The Crescent Electric Company has been incorporated with a capital stock of $25,000 to deal in electrical appliances of every description. The incorporators are Henry W. Jackens, M. Deckhaus and Alfred W. Rake, of Bayonne.

DULUTH, MINN.—The Head of the Lakes Electrical Construction Company has been organized at Duluth with a capital of $50,000. The purposes of the organization are given as being to construct, purchase, sell and generally deal in electrical and mechanical plants and to do a business in things that are connected with such plants. The incorporators are: Charles Burgeson, W. E. Armour, M. J. Healy and J. A. Waugh.

ROCHESTER, N. Y.—Hereafter the co-partnership of John J. Finucane, John W. Cook and Harry P. Sickels will be known as the Rochester Electric Contracting Company, papers of incorporation having been filed with the secretary of state. The purposes of the company as given in the papers of incorporation are: To construct, erect and install, alter, repair, equip and deal in works, plants, instruments and machinery for supplying and distributing electricity for light, heat, power and other purposes, and in general to make or otherwise equip and carry out any contracts and do a general contracting business, to do electrical work of every kind, nature and description, including the business of electrician, electrical and mechanical engineer, and dealer as principal or agent in electric motors, dynamos electrical machinery, appliances of any nature or kind whatsoever, in relation to the construction, erection, equipment and improvement of public or private works or buildings. The three partners are the directors of the company and the only stockholders, the company beginning with a capital stock of $5,000.

SEATTLE, WASH.—Articles of incorporation have been filed at Olympia for the Northwestern Electric Company, a concern organized by local capitalists for the purpose of manufacturing electrical appliances of all kinds. The capital stock of the company is $250,000, which has already been subscribed. The company will, in a short time, begin the erection of a large plant in the south end of the city, the exact site of which has not yet been determined, but which will probably be along the route of the Tacoma-Seattle interurban. The incorporators of the new company are Andrew Chilberg, president of the Scandinavian American Bank; E. C. Kilbourne, Nelson Grimsley, L. B. Stedman, F. A. Ernst, E. W. Forester, A. E. Ransom, G. E. Smith and S. A. Flower. A. E. Ransom has been retained as president and manager and will have general supervision of the plant. G. E. Smith has been selected as secretary and sales manager. The new company will absorb the Seattle Electrical, Heating and Manufacturing Company, a concern that has been doing business here for some time. This company has maintained an establishment at Los Angeles and, while that branch will be retained, all the patents, property, rights and interests of the company here will be turned over to the Northwestern Electric Company.

ELECTRIC RAILWAYS.

FINDLAY, OHIO.—The Toledo, Urban & Interurban will extend its line to Kenton.

LONDON, ONT.—Fire on August 10 destroyed the car barn of the Southwestern Traction Company in South London. Five cars were also burned. The loss was $75,000, fully covered by insurance.

PHILADELPHIA, PA.—The July gross earnings of the Lehigh Valley Transit Company were $99,000, an increase of $7,350 over the preceding July. For the first two weeks of August gross increased $4,650.

ELKINS, VA.—The Elkins Electric Railway Company will do its own construction, building a line in Elkins and also an extension from Elkins to Belington, twelve miles and possibly farther. J. C. McSpadden is president of the company.

HAMMOND, IND.—The Chicago, Lake Shore & South Bend Railway Company, whose through line from Michigan City to Chicago extends through Hammond, is to be given a franchise for the construction of a street railway system in Hammond.

WARSAW, N. Y.—The corps of engineers for the Rochester & Caledonia trolley line have completed their work on the proposed extension from Caledonia through Le Roy to Batavia and have begun laying out the line for the branch south to Pavilion, Warsaw and Perry.

ST. LOUIS, MO.—First articles of incorporation have been issued to the Interurban Express Company, of Belleville, showing a capital stock of $50,000. The company is backed by local and St. Louis merchants and is organized to do an express business on the lines of the East St. Louis & Suburban Railway Company.

ITHACA, N. Y.—The Ithaca common council has granted a franchise to the Ithaca Street Railway Company for a double track. The feature of the franchise was a provision that tickets be sold six for twenty-five cents. Two months ago the company abolished a commutation book rate of twenty-three tickets for $1 and 100 tickets for $4.

ROYERSFORD, PA.—Citizens of Royersford have inaugurated a movement for a trolley system for the town. Plans and proposed routes from Royersford to the Trappe were submitted with a view to making connection with other lines. A committee was appointed to confer with the officials of the Schuylkill Valley Trac-

tion Company. The proposed route will give a direct line to Philadelphia.

ASHEVILLE, N. C.—If present plans are perfected, the towns of Waynesville and Canton will be connected by an electric railway. It is now stated that the Champion Fiber Company, of Canton, is interested in the project. The distance between the two places is about ten miles, and the proposed line will run through one of the richest agricultural sections in western North Carolina.

BILLINGS, MONT.—If present plans do not miscarry, this valley and the surrounding country will be connected by electric lines. Yegen Brothers, of this city, are behind the move and the power that will be used will come from the new power-house that the Yegen company has been putting up south of the city. It is planned to connect Columbus, Laurel, Park City, Huntley and Bear Creek with Billings.

MINERAL WELLS, TEX.—The contract for the building of an interurban railway connecting Mineral Wells and Fort Worth has been signed by Major Beardsley and E. W. Barrows, secretary and treasurer of the American Engineering Company, of Indianapolis. The contract provides for the beginning of construction work at once; the line to be completed and in operation within twelve months.

HARTFORD, CT.—From present indications there will be nothing to prevent the running of the electric interurban line between Rockville and Hartford by September 1. With the completion of the wiring in the Rockville railroad yard the line is wired right through and already to run. The substations at West street, Rockville, and Buckland, are equipped with machinery. The poles are up on the Melrose line and the wires strung.

PASADENA, CAL.—Another electric railway to Pasadena is promised by men who represent Los Angeles capital. They have already taken steps for the formation of their company, and preliminary work has been started toward securing franchises and rights of way over the contemplated route. M. A. King, of Los Angeles and Glendale, has been in conference with city officials and property owners here in behalf of the men behind the enterprise.

CHICAGO, ILL.—The Chicago Electric Traction Company has passed into the hands of the owners of the interurban electric road being built from Chicago to Kankakee. The Chicago Electric Traction Company had been in the hands of Receiver Charles Henrotin through order of Judge Kohlsaat for some time. It runs from Blue Island to Sixty-third street and South Park avenue. The promoters of the Kankakee-Chicago line propose to extend the route to Peoria and Springfield during 1908.

COLUMBUS, OHIO—Clyde J. Kneisely, Michael Siebold, E. S. Rhoades, W. W. Snyder, F. G. Knenzli, W. J. Wise, T. F. Hynes and F. O. Richards have incorporated the Valley Transit, Light and Power Company, of New Philadelphia, with a capital stock of $100,000. The company is to construct and operate an electric railroad between the cities of Canton, Dover, New Philadelphia, Newcomerstown, Coshocton, Newark and Columbus and in the counties of Stark, Tuscarawas, Coshocton, Muskingum, Licking and Franklin. It also can operate coal mines and own and operate pleasure parks.

DAVENPORT, IOWA—Articles of incorporation of the Davenport & Manchester Railway Company, which expects to connect Davenport with Manchester and Monticello by electric line, have been filed. The articles of incorporation name L. Matthews, J. A. Voorhees, F. H. Miller, F. W. Rank, George T. Baker, T. F. Halligan and Henry Vollmer as the first board of directors. The officers of the company are as follows: president, George T. Baker; vice-president, J. A. Voorhees; secretary, F. W. Rank; treasurer, T. F. Halligan.

KENOSHA, WIS.—Agents of the Chicago & Milwaukee Electric Railway Company in Kenosha state that plans have been completed by which the cars of this company will be running about the loop in Chicago by the first of November. The cars are to enter Chicago from Evanston over the lines of the Chicago, Milwaukee & St. Paul Evanston branch, which is to be equipped for electric cars. This will make it possible to connect with the Northwestern elevated at Wilson avenue, and from this point the run will be over the tracks of that road.

ANDERSON, S. C.—From a director of the Donald's & Due West Railroad it is learned that the Anderson Traction Company, of which E. W. Robertson, of Columbia, is president, will take charge of the uncompleted road between Donald's and Due West and will construct an electric road between these two points. It is also understood that the company will construct a line between Belton and Donald's, a distance of fourteen miles. The distance between Donald's and Due West is four miles and the railroad company, which was organized several months ago, has graded the route and has laid the cross-ties.

JACKSON, MICH.—The building of the new electric line joining Jackson and Lansing is now assured. The contract for grading the road bed from Lansing to Mason has been let by the Northern Construction Company to W. E. Tench & Company, of Detroit. Work will be begun at once on the grade and President T. W. Atwood of the construction company says that cars will be running between Lansing and Mason City by December 1. No work will be started on the road south of Mason, it being the policy of the company to begin constructing only the portion which can be completely finished before winter weather sets in.

REDLANDS, CAL.—The Mile High railway, the line for which C. S. Chesnut and G. H. Dunn have franchises, to connect Redlands with Oak Glen, running through the Yucaipe Valley, is to be in operation by next spring, according to the promoters. They have given orders for ten cars to be used on the line, and these are to be delivered by the Westinghouse Company by early spring. The cars ordered are four passenger, two express and four trailers for carrying the fruit and other products of the Yucaipe Valley to market. Each car is to be equipped with four 125-horse-power motors for alternating current. Two stations will be built on the line, one three miles from Oak Glen and the other in Yucaipe city.

PARKERSBURG, W. VA.—The Muskingum Traction Company, a branch of the Parkersburg, Marietta & Interurban line, has been incorporated under the laws of the state of Ohio and has received a charter. The terminals of the line are Marietta and Beverly. It has a capital stock of $30,000. The Parkersburg, Marietta & Interurban is incorporated under the laws of this state and it was necessary to incorporate the other in Ohio. The line is being extended from Rainbow to Lowell. The directors of the concern are: C. H. Shattuck, of Parkersburg; W. W. Mills, A. D. Follett, C. C. Torpy and W. H. H. Jett, of Marietta. The directors held a meeting and elected the following officers: president, C. H. Shattuck; secretary, C. C. Torpy; general manager, W. H. H. Jett.

DOYLESTOWN, PA.—The Philadelphia & Easton Transit Company at a reorganization meeting of the bondholders in Doylestown elected the following officers: president, David P. Ayars, of Wilkes-Barre; secretary and treasurer, Joseph S. Rawson, of Philadelphia; diretcors, David P. Ayars, of Wilkes-Barre; A. H. Sickler, of Philadelphia; W. J. Lescure, of Harrisburg; A. E. Pendergast, of Trenton; Henry R. Rush, of Lancaster, and A. C. Patterson, of Philadelphia. The road was purchased May 31 at a trustees' sale for $100,000, subject to an indebtedness of $825,000, by a committee representing the bondholders. The new owners have taken possession of the road, and it will be managed by an executive committee under the name of the Philadelphia & Easton Electric Railway. The new company will make improvements, and will put on a larger number of cars.

LITTLE ROCK, ARK.—The Russellville & Ozark Mountain Traction, Light and Power Company, of Pine Bluff, has been incorporated with a capital of $200,000. W. H. Langford, James Gould, Irving Reinberger, M. M. Bruce, Adam J. Robinson, J. B. White, Tom D. Brooks, A. S. Hays, A. B. Plastow, E. Stovenken and Adam J. Robinson are the incorporators. Adam J. Robinson is president of the company; J. C. Wilson, vice-president; James Gould, secretary, and W. H. Langford, treasurer. The company is organized to build, own and operate an electric interurban road between the city of Russellville and other cities or towns in the state of Arkansas, and to manufacture, sell and supply electrical energy. The place of business is at Pine Bluff, and a majority of the incorporators are from that city. James Gould is ex-sheriff of Jefferson County, and at present County Judge of the same.

ELECTRIC LIGHTING.

HAVANA, ILL.—Carl Miller, of Havana, will install an electric light plant at Manito.

COLUMBIA, TENN.—The board of mayor and aldermen of Columbia is contemplating ownership of its light and water plant, and is investigating the matter.

PITTSTON, PA.—The directors of the Citizens' Electric Illuminating Company of Pittston have agreed to increase the capital stock of the company from $40,000 to $200,000.

TORREON, MEX.—The Torreon & Laredo Electric Light Company has closed a deal for new equipment that will cost $200,000. General improvements will be made to the service.

CARSON CITY, NEV.—Mike Fay, one of the prominent ranchers in Carson valley, expects to complete the installation of an electric plant at his ranch within a short time.

ALLENTOWN, PA.—A committee of councils has discovered that Allentown pays the highest rate of any third-class city in the state for its street arc lamps—$84 a year. Chester comes next, with $80 a year, and Reading is third, with $78.

GLOBE, ARIZ.—The electric light and gas plants at Globe are to be improved. Property with a frontage of 162 feet and a depth of 270 has been purchased for the erection of a new electric light plant, the contract for the building having been awarded to J. F. Briggs.

TOWANDA, PA.—Lights all night and every night will illuminate the streets of this city, which have been dark for three months, after September 1. The lighting committee of city council has been instructed to make a lighting contract with the Towanda Electric Illuminating Company.

MARQUETTE, MICH.—Announcement is made of the sale of the holdings of the Electric Light and Power Company, of Munising, to M. A. Doty, vice-president and general manager of the Superior Veneer and Cooperage Company. The plant has been extensively improved during the past few years.

MUNCIE, IND.—Nineteen new lights, for which the council made a special appropriation recently, have been ordered erected by the board of works. The Muncie Electric Light Company has been notified of the order and it is expected that the extensions will be made in the next few weeks.

DAYTON, OHIO—A mortgage in the sum of $1,500,000, given by the Dayton Citizens' Electric Light Company to the Cincinnati Trust Company to secure the payment of bonds, has been released at the county recorder's office, the obligation having been met. The document bore the signature of George B. Cox.

LA JOYA, MEX.—Work is to start within three months on the hydroelectric power plant at La Joya on the Conchos, from which it is proposed to supply cheap power to Chihuahua, Santa Eulalia, Parral and other places. The La Joya enterprise has been pronounced by able engineers as entirely feasible and the site selected as an ideal one.

ALBANY, N. Y.—The Newport Electric Light Company has been given consent to issue $65,000 bonds under a mortgage for $75,000, the proceeds to be used for rebuilding a part of its plant and for extensions to the villages of Cold Brook and Poland, Herkimer county. Louis C. Whiton, president of the company appeared to explain its application.

ASHTABULA, OHIO—A. S. Metcalf has filed his report with the uniform bureau of accounting on the electric light plant of Ashtabula. The earnings of the plant during the past year were $8,088.04. Allowing seven and one-half per cent in depreciation, the net earnings are $2,322.44. The present value of the plant is $71,109.03. Good management is reported.

LEMONT, ILL.—The Economy Light and Power Company has closed a contract for the purchase of the Lemont Electric Light Works and will take over the plant immediately. The existing dynamos and machines will be abandoned and the power necessary to fill contracts will be secured from the Chicago Edison company. The price paid for the Lemont plant is said to have been about $10,000. The purchase includes a city contract for lighting. This is at the rate of $75 a light.

MOUNT VERNON, N. Y.—The Westchester Lighting Company has made a decided reduction in the cost of electric lighting. The rates heretofore charged were twenty cents per kilowatt-hour to the small consumer, with a scale of discounts to larger users. Under the proposed reduction the maximum rate per kilowatt-hour will be thirteen cents flat.

WATERTOWN, N. Y.—The municipal authorities of the village of Adams have filed formal complaint about the rates charged by the Adams Electric Light Company with the Public Utilities Commission. Eighteen cents a night, or about $65 a year, is charged for arc lights for commercial purposes and the charge for public purposes is twenty-seven cents a night. The charge for incandescent lamps is from two and one-half to three cents a night.

BRISTOL, TENN.—The syndicate that proposes to expend $600,000 in developing the power of Holston river at Fish Dam, for electrical purposes, has obtained a thirty-year franchise for lighting in Bristol, Va., and will secure a similar franchise in Bristol, Tenn. The new concern has already spent probably $10,000 in obtaining rights of way, options, etc., and the project is assured. About 7,000 horse-power will be produced, to be used for power and illuminating purposes.

CLARKSTON, WASH.—The Lewiston-Clarkston Company is engaged in the installation of a power plant at the base of the pipe leading from the new high line pipe to the reservoir constructed in Pomeroy gulch. The drop in the pipe is approximately 220 feet and will generate about 600 horse-power. During the irrigation period this power-plant will be almost continually in operation and will greatly relieve the Asotin creek station and the steam plant on Snake river.

MARINETTE, WIS.—The electric power transmission line between Peshtigo and Oconto is now under construction and will be in operation by September 15. The power will come from a dam on the Peshtigo river owned by the Perley Lowe Company, and the line will furnish Oconto with light and power. The line will be about fourteen miles long and will cost $14,000. Several projected power lines may be built here within another year, one from the upper Peshtigo and the other from the Grand Rapids on the Menominee.

TACOMA, WASH.—All bids for furnishing the city with a steam power plant have been recommended eliminated from consideration by the fire and water committee of the council. Consideration of the one proposal for a hydraulic plant was referred to the committee of the whole. This bid, which remains to be taken up, unless the whole council reverses the decision of the committee, is that of the George Milton Savage Construction Company to build a 10,000-horse-power system on the upper Nisqually river for the sum of $1,750,000.

TROY, N. Y.—I. M. Everest, of Albany, a representative of the McCaffrey Water Motor and Power Company, of Troy, has been securing options on the water privileges along the Caroga and Peck creeks. It is understood that the firm has secured the control of the water privileges from Caroga Lake to the Mohawk river and from Peck's pond to its connection with the Caroga creek. It has been intimated that several large power stations are to be erected for a general distribution of electric power in Montgomery, Fulton and Herkimer counties.

HAMILTON, ONT.—To install a municipal lighting plant when the Cataract Power Company's contract for supplying the city with arc lamps expires in July, 1909, would cost over $121,000, according to an estimate supplied by T. W. Sothmen, chief engineer of the Hydro-Electric Commission. The Cataract company has quoted $60 a lamp for a ten-year contract and $65 for five years for 500 arc lamps. W. A. Logie, of Chisholm & Logie, on behalf of an unknown company, offered to supply 500 arc lights at $55 for ten years and $60 for five years. The present price averages about $82.50.

ROCKLAND, MASS.—The gas and electric light commissioners have granted the Electric Light and Power Company of Abington and Rockland permission to issue $60,000 of new stock. Since June 1, 1906, when the property passed into the hands of its present owners, the company has been engaged in making substantial additions to its plant, including the extension of its business into the town of Hanover and the construction of a trans-

mission line from the works of the Brockton company. Prior to May, 1907, nearly $30,000 was expended on account of this work.

PASADENA, CAL.—Enlargement of the municipal electric lighting plant has been officially agreed upon by the members of the electric light and supplies committee of the city council. This decision means that about 150 additional lights are to be added to the number now in use, independent of whatever action may be taken upon the recommendation of Ezra F. Scattergood, the electrical engineer who has been employed by the city as an expert to review estimates made by Manager C. C. Glass for the proposed expenditure of about $200,000 for doubling the present capacity of the lighting plant.

CUMBERLAND, MD.—The Youghiogheny Light and Power Company, of Garrett county, has been incorporated at Oakland, and the company will locate a plant below Deep Creek Falls, seven miles north of Oakland, for the purpose of generating electricity for commercial uses. It is the intention to concentrate at this point the wasted water power of the Swallow Falls in Yough river, the Deep Creek Falls and the Muddy Creek Falls, and turn it into electrical energy to be distributed to Oakland, Mount Lake Park, Deer Park, Grantsville, Accident, Friendsville and other towns in Garrett county, to Kingwood and nearby points in West Virginia and to nearby points in Pennsylvania.

COLUMBUS, OHIO—According to the figures of Examiner Leslie C. Smith, of the bureau of public accounting, it costs the town of Nelsonville $88.14 per light per annum under the municipal ownership system in vogue there. This is for city lighting only, and Mr. Smith shows that the expenditures in some of the months during the examination period were far greater than the receipts. In the waterworks department there is a deficiency of $57.90 on the treasurer's books that occurred in May, 1906. This plant was considerably damaged by high water during the spring and has never been fully repaired, necessitating a shortage of water supply to many of the population living on the hills.

BEDFORD, IND.—The Pittsburg Electric Power Company, represented by S. A. Teacher, has made public its intention of erecting a large plant just south of the city on White river, near the old site of Palestine, for the furnishing of electric power. An immense dam will be constructed across White river, of solid masonry thirty feet high, and the plant will cost at least $500,000. Options have been secured on several large tracts of farm land that would be seriously damaged by the back water from the dam. The plan is to furnish electric power to the plant of the United States Cement Company and all the large stone mills in and around Bedford, as well as other industries; also for an electric railway.

EAST SYRACUSE, N. Y.—An agreement has been reached between the members of the village board of trustees and James DeLong, a representative of the Syracuse Lighting Company, by which a contract will be renewed between the village and the company for the lighting of the village, the old contract or franchise having expired over a year ago. Under the old terms, arc lamps cost $85 per year and incandescent lighting twelve cents per kilowatt-hour. By the terms of the new contract the company agrees to reduce the cost per lamp per year $15 each, or to $70 for each lamp, while the price for incandescent lights is fixed at eight cents per kilowatt-hour, beginning October 1, a reduction of four cents per kilowatt-hour.

MEMPHIS, TENN.—J. A. Omberg, Jr., former city engineer, has, through his attorneys, offered an ordinance to be passed by the city council of Binghamton, which ordinance embodies a contract with the parties he represents and the city of Binghamton for the erection of an electric light plant. The company does not make a request for a franchise, but asks that the city grant rights of way through streets and alleys, and other privileges to do business in the town. In the ordinance is a provision which gives the city the right to buy over the plant upon six months' notice. It is the intention of the town of Binghamton to later take over all public utilities. The effort of the council for the present, however, is to secure independent lighting and water plants.

STOCKTON, CAL.—The Stanislaus Electric Power Company, which has contracted to deliver electricity in San Francisco by next February from its great plant on the Stanislaus river, in Tuolumne county, is procuring rights of way for the transmission line through San Joaquin county. Rights through Calaveras county from the plant twelve miles east to Vallecito have been procured, and the line will be run straight from that point to San Francisco. It is planned to supply 30,000 horse-power, and the company is operating with a capital of ten millions. More than a million dollars has been laid out in the work so far done. The transmission line is to be carried on steel towers fifty feet high, placed from 800 to 1,000 feet apart. Storage reservoirs are being built on the upper Stanislaus watershed.

TACOMA, WASH.—A petition has been filed in the Superior Court by the Nisqually Power Company to acquire by condemnation the right to divert from its present channel the water of the Nisqually river, part of which lies in Pierce county and part in Thurston county. The defendants to the action are the Northern Pacific Railway, J. L. McMurray, Arthur R. Warren, Henry Hewitt and others. The purpose is to secure use of the water power to establish electrical power plants to operate electric lighting and railroad systems. Condemnation proceedings have been begun in Thurston county, also, to acquire rights on the Thurston side of the river. The location is a short distance from Eatonville. The company asks for 2,000 cubic feet a second, generating 20,000 horsepower. The power is wanted primarily for the Felt system of trolley lines.

INDUSTRIAL ITEMS.

THE SPRAGUE ELECTRIC COMPANY, 527 West Thirty-fourth street, New York city, has just published bulletin No. 108, devoted to electric dynamometers for testing gasolene engines.

DOSSERT & COMPANY, INCORPORATED, 242 West Forty-first street, New York city, has issued a very interesting and comprehensive catalogue devoted to the Dossert solderless electrical connectors or cable joints for stranded and solid wire. This catalogue will be sent to any one interested upon request.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has received through G. & O. Braniff & Company, agents for the former company in Mexico, an order for one of the electrical equipments of the Vera Cruz tramways, built by the Vera Cruz Light, Power and Tramway Company. Vera Cruz is the second city in Mexico to be electrified.

THE WATSON-STILLMAN COMPANY, 25 Dey street, New York city, has published a handsome catalogue devoted to a description of its hydraulic forcing presses. Nearly one-half of the matter contained in this catalogue has never been shown before. The book is replete with interesting information and illustrations devoted to this type of machinery. Copies will be sent upon request.

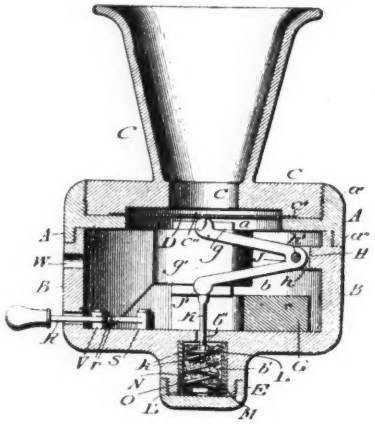
THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has issued a booklet of pigeon-hole size, devoted to electric crane controllers. In addition to the descriptive matter and illustrations, covering five types of crane and hoist controllers, dimension diagrams, repair part charts, prices, net weight and shipping weight of apparatus are given. An improved form of contactor for handling heavy currents is also described.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has ready for distribution bulletin No. 4527, devoted to Thomson polyphase induction wattmeters. These wattmeters are made for the specific purpose of measuring energy in any two-phase three-phase or monocyclic circuit, and consist of two single-phase motor elements, each acting upon its own disc, with both discs mounted upon a single shaft actuating the register. The meters may be applied to a circuit carrying a mixed load of lamps, motors, or other devices, and record accurately irrespective of load conditions. They are made in three types; one for house service with metal cover, and two for switchboard use, one having a metal cover and the other a glass cover. The bulletin gives catalogue numbers and capacities, etc., of the various sizes, and a large number of connection diagrams showing the method of installation on different classes of circuits.

Record of Electrical Patents.

Week of August 20.

863,609. ELECTRICALLY SIGNALING FROM MOVING TRAINS. Alva D. Jones, Louisville, Ky., assignor of fifty and one-half one-hundredths to Theodore Harris, W. O. Bradley, and James Gayle, twenty one-hundredths to Frank A. Fuller, Edgar D. Martin and Aaron G. Martin, and seven one-hundredths to John C. Strother. A metallic brush makes contact from the train.



863,617.—COMBINED TELEPHONE RECEIVER AND TRANSMITTER.

863,617. COMBINED TELEPHONE RECEIVER AND TRANSMITTER. Rodney F. Ludlow, Philadelphia, Pa. A common diaphragm is used for transmitting and receiving.

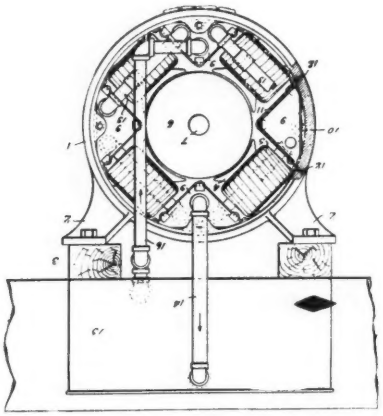
863,629. COMBINED DROP AND JACK. James M. Overshiner, Chicago, Ill. The insertion of the plug restores the drop.

863,656. SAFETY-FUSE. Joseph Sachs and Frank D. Reynolds, Hartford, Ct., assignors to The Sachs Company, Hartford, Ct. An enclosed fuse.

863,667. RELAY. Jacob B. Struble Wilkinsburg, Pa., assignor to The Union Switch and Signal Company, Swissvale, Pa. A three-legged relay with pivoted armature.

863,674. JOINT FOR CARBON ELECTRODES. Frank J. Tone, Niagara Falls, N. Y. A tapered screw joint.

863,683. BRUSH-HOLDER FOR ELECTRIC MOTORS OR THE LIKE. Thomas S. Watson, Milwaukee, Wis. The brush slides in tapered guides.



863,814.—DYNAMOELECTRIC MACHINE.

863,692. SYSTEM OF ELECTRICAL DISTRIBUTION. William L. Bliss, New York, N. Y. A storage battery is used.

863,705. TELEPHONE SIGNAL SYSTEM. Howard M. Eldred, Milwaukee, Wis. The grounding connection at each instrument cuts out that bell.

863,720. TELEPHONE CALL-BELL OR RINGER. William Kaisling, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. A polarized ringer with parallel magnets.

863,755. CONTROLLING APPARATUS FOR RAILROAD SIGNALING. Petrus J. Portman, Amsterdam, Netherlands. The signaling circuits are controlled by a contact dial.

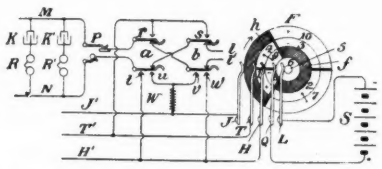
863,773. LIGHTNING ARRESTER. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. A reactance in parallel with condensers and shunted by a spark-gap.

863,774. PARALLEL-CONNECTED GENERATORS. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. A device to decrease the field strength of the generator having the best regulation.

863,791. PROTECTIVE DEVICE. Loren Emery, Schenectady, N. Y., assignor to General Electric Company. A relay provided with differential shunt and series windings.

863,793. FORMING FILAMENTS OUT OF VISCOSE OR SIMILAR VISCOUS MATERIAL. Charles A. Ernst, Lansdowne, Pa. Soda-cellulose is treated with carbon bi-sulfid.

863,799. ELECTRIC METER. Charles E. Holmes, Lynn, Mass., assignor to General Electric Company. The operating mechanism may be removed from the case.



863,875.—SYSTEM OF SELECTIVE ELECTRIC SIGNALING.

863,814. DYNAMOELECTRIC MACHINE. Louis E. Underwood, Lynn, Mass., assignor to General Electric Company. A cooling fluid is circulated through tanks on the machine.

863,818. RAIL-BOND. Ben Willard, New Orleans, La., assignor to General Electric Company. A single conductor with a plurality of contacts.

863,847. ELECTRICAL-SOCKET SEAL. Llewellyn T. Hatfield, Sacramento, Cal. A plug and seal for closing sockets.

863,852. TRANSMISSION OF INTELLIGENCE BY ELECTRIC MEANS. Isidor Kitsee, Philadelphia, Pa. Two local circuits, more or less remote from each other, connected by a line.

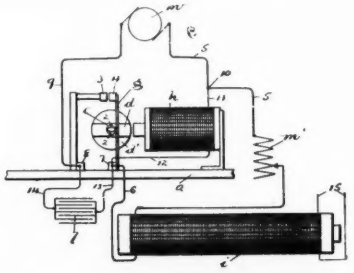
863,853. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. Two equal and opposing batteries are placed at opposite ends of the line.

863,875. SYSTEM OF SELECTIVE ELECTRIC SIGNALING. Sylvanus A. Reed, New York, N. Y. A telephone signaling system.

863,913. BLOCK-SIGNALING APPARATUS. Walter E. Foster, Chicago, Ill., assignor to the Union Switch and Signal Company, Swissvale, Pa. A signal lock at one station is operated from the next.

863,924. SELECTIVE SIGNALING SYSTEM. William W. Kidney, Buffalo, N. Y., assignor to Century Telephone Construction Company, Buffalo, N. Y. A selective telephone system.

863,955. INTERRUPTER APPARATUS. Reinhold H. Wappler, New York, N. Y. A rotating interrupter.



863,955.—INTERRUPTER APPARATUS.

863,956. ELECTRICAL CLOTH-CUTTING MACHINE. Edward M. Waring, New York, N. Y. A motor-driven knife.

863,969. TELEGRAPH AND TELEPHONE CABLE CORE. William Dieselhorst, Old Charlton, and Arthur W. Martin, London, England. The length of lay is different for pairs of conductors and pairs of pairs.

864,027. AUTOMATIC CIRCUIT-CLOSER. Henry A. Pearson and Harry Adams, U. S. Navy. An electric magnet for opening the controller circuit.

864,048. ELECTRIC TIME-SWITCH. Bernhard Tropp, New York, N. Y., assignor of one-half to William Henry Laird, New York, N. Y. A clock-driven mechanism closes the circuit periodically.